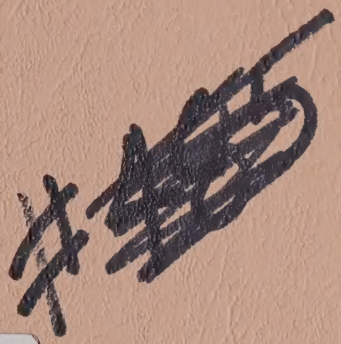
#65

OPERATION & MAINTENANCE

HANDBOOK



MODEL 108

PULSE GENERATOR

PART NO. 37000-209

DATAPULSE®

A SUBSIDIARY OF SYSTRON-DONNER CORPORATION

OPERATION & MAINTENANCE

HANDBOOK

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A SUBSIDIARY OF SYSTRON - DONNER CORP.
10150 W. JEFFERSON BLVD., CULVER CITY, CALIF.

MODEL 108 PULSE GENERATOR

The Datapulse Model 108 Pulse Generator is an all solid state, high quality pulse generator combining functions previously unavailable in commercial pulse generators.

The instrument features clean, high power pulses, high duty cycle capability, fast rise times, and high repetition rates. Coupled with these features is the capability to generate clean, wide, low power pulses at low repetition rates. The 108 is designed to perform most pulse applications conveniently and with the utmost reliability.

This operation and maintenance handbook contains general and detailed instructions for operation and maintenance of the Model 108. A complete understanding of its contents will contribute greatly to full utilization of the broad capabilities of this instrument.

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SCHEMATICS

Drawing No.	Description
40000-052B	Schematic - Power Supply
40000-053A	Schematic - Attenuator 50 dB
40000-055B	Schematic - Front End
40000-056B	Schematic - Output Amplifier
40000-057B	Schematic - Power Supply Output Amplifier

ADDENDA AND ERRATA

WARRANTY

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SECTION I

SPECIFICATIONS

1.1 REPETITION RATE

Continuously variable from 10 c/s to 10 Mc/s, covered in six decade ranges.

1.2 EXTERNAL TRIGGER

Sync Output occurs at a fixed delay of approx. 130 nanosec. from external trigger. Unit operates at 0 to 10 Mc/s from ±5V pulses (30 nanosec min. duration) or at 10 c/s to 10 Mc/s from 4V rms sine waves. Polarity and sensitivity controls provide for reliable triggering at any point on the input waveform more than 5V above or below average dc level. Input impedance is approx. 5,000 ohms. Maximum signal level which may be applied with sensitivity control at max. is ±10V.

1.3 SINGLE PULSE

Operation of a front panel pushbutton provides one cycle of output.

1.4 GATED OPERATION

External gate signal levels more negative than minus 6V block main pulse output, no connection or levels more positive than minus 2V enable. Gate signal must furnish approx. 3 mA during disabling. Levels greater than ±25V may not be applied.

1.5 SYNC OUTPUT

Selectable either pos. or neg., variable from approx. 0.25V to at least 6V into 50 ohms (approx. 15V open circuit, 10V into 100 ohms). Pulse width is approx. 20 nanosec., rise time approx. 7 nanosec.

1.6 MAIN PULSE DELAY (of minimum rise time leading edge from Sync Output)

Continuously variable from 0 to 5 millisec., covered in five decade ranges. Max. delay duty cycle is greater than 50% of pulse spacing, externally or internally triggered.

1.7 MAIN PULSE DURATION (at 50% amplitude point of minimum rise time waveform)

Continuously variable from less than 25 nanosec. to 5 millisec., covered in five decade ranges. See Main Pulse Output for duty cycle limitations.

1.8 JITTER, ACCURACY, AND STABILITY

Jitter is less than 0.1% plus 0.5 nanosec. Full scale accuracy of each range is nominally ±5% (±7% max.). Stability (typical change with line voltage variation of ±10%) is better than ±0.2%.

1.9 MAIN PULSE OUTPUT

Direct coupled, selectable as Positive, Off, or Negative.

1.9.1 Amplitude

Continuously variable from 0.2 to 50V into 50 ohms (0 to 50 dB attenuation) covered in 2 dB steps plus fill-in. Steps are calibrated in volts into 50 ohms, accuracy approx. ±5%. Line voltage variations have negligible effect on pulse amplitude.

1.9.2 Baseline DC Level

Less than 1 mv at full amplitude, reducing with attenuation, except for the effect of leading edge and trailing edge waveform aberrations at high duty cycles above 2 Mc/s (which are typically less than 2% of pulse amplitude).

1.9.3 Source and Load Impedance

Output is a voltage source (pulse-top diode clamped) presented through a constant impedance 50 ohm attenuator, i.e., source impedance is approx. 50 ohms at amplitudes of 10V and less. Unit is designed for operation into a 50 ohm load and is overload protected against output shorts or loads less than 40 ohms.

1.9.4 Duty Cycle and Overload Protection

Max. pulse width duty cycle is 50% (except 40% max. with pulse widths greater than 2 millisec.). Automatic overload protection against excessive duty cycle, output shorts, or loads less than 40 ohms causes pulse distortion, reduces average current by disabling output for approx. two second periods, and is indicated by a panel lamp. Operation returns to normal when overload condition is corrected.

1.9.5 Back Voltages

Opposite polarity voltages in excess of approx. 500 mV are diode clamped to ground, fully protecting output transistors unless more than approx. 300 mA is provided by the back voltage source. Same polarity voltages are diode clamp limited to the pulse amplitude and are further limited by attenuator power ratings to 35V dc max. (10V dc max. at pulse amplitudes less than 16.5V).

1.9.6 Rise and Fall Time (with 50 ohm resistive load)

Less than 7 nanosec. for rise time and 13 nanosec. for fall time with control at min. Both may be increased simultaneously to at least 50 nanosec. (typically 80 nanosec. max.) with exponential waveform. (Amplitude is reduced slightly at increased rise time, 50V max. is available at 50 nanosec. rise and fall time.)

1.9.7 Waveform Aberrations (with properly connected 50 ohm resistive load)

Overshoot, undershoot, ring and top slope are typically ±2% (±4% maximum) at amplitudes greater than 5V, increasing to ±7% maximum at 200 mV (except at less than 500 mV with transition times less than 9 nanoseconds).

1.10 POWER

105 - 125V, 50/60 c/s ac, approximately 150W maximum.

1.11 OPERATING TEMPERATURE

Designed for operation at 0 to 50°C ambient.

1.12 PHYSICAL

Aluminum front panel with etched black and red markings, beige cabinet with quick-release top and bottom covers, forced air cooling with filter. 8-3/4" high by 17" wide by 15-1/4" deep. May be rack mounted (8-3/4" high by 19" wide panel space) by specifying Model 108R or by installing Type 1002 Rack Mounting Set. Net weight is approximately 33 pounds, shipping weight approximately 45 pounds. All signal connectors are BNC type.

1.13 ACCESSORIES FURNISHED

One operation and maintenance handbook, 8 foot line cord with NEMA 3-prong plug.

1.14 ACCESSORIES AVAILABLE

Four foot 50 ohm cable with BNC connectors (Type 4048), 50 ohm 15 watt Power Termination (Type 2003), rack mounting set (Type 1002), additional operation and maintenance handbooks.

SECTION II

OPERATING INSTRUCTIONS

2.1 DESCRIPTION OF CONTROLS AND CONNECTORS

2.1.1 Power ON Switch

Connects or disconnects ac input voltage to transformer primaries and fan motor within the instrument. The pilot lamp above the switch lights when the power is on.

2.1.2 Repetition Rate

The black outer knob selects the repetition rate range. There are six ranges each covering one decade of frequency. One position is provided for single pulse operation and one position for external triggering with positive going waveforms and one position for triggering with negative going waveforms.

2.1.3 Repetition Rate--Vernier

The red inner knob provides continuous fill-in between ranges of the repetition rate control. With this control fully clockwise, the instrument is calibrated at the frequency shown by the repetition rate control.

2.1.4 Single Pulse--Push Button

Each depression of the button initiates one cycle of output when repetition rate control is in single pulse position.

2.1.5 Trigger Input

BNC connector which accepts a pulse or sine wave to slave a Schmitt trigger to outside signal when repetition rate control is in EXT.

2.1.6 External Sensitivity

Adjusts the level on an external signal at which the instrument triggers.

2.1.7 Sync Output

This BNC connector provides a narrow output pulse on each cycle which serves as a zero time reference for the delay circuit.

2.1.8 Sync Polarity

This switch controls the polarity of the sync output pulse.

2.1.9 Sync Volts into 50Ω

This control adjusts the amplitude of the sync output pulse. When the sync pulse is loaded with 50 ohms the amplitude is continuously variable from .25V to more than 6V.

2.1.10 Gate Input

This BNC connector provides an input for an external gating signal. When an applied dc level is more negative than -6V, output pulses are disabled. Maximum input is ±25V.

2.1.11 Pulse Delay

The black outer knob selects the delay range. There are five ranges, each covering one decade.

2.1.12 Pulse Delay--Vernier

The red inner knob provides a continuous fill-in between ranges of the control. With this control fully counter clockwise the instrument is calibrated at the delay shown by the pulse delay control.

2.1.13 Pulse Width

The black outer knob selects the width range. There are five ranges each covering one decade.

2.1.14 Pulse Width--Vernier

The red inner knob provides continuous fill-in between ranges of the control. With this control fully counterclockwise the instrument is calibrated at the width shown by the pulse width control.

2.1.15 Amplitude Range--Pulse Volts With 50Ω Termination

Two concentric switch dials indicate the magnitude of the output voltage when the vernier control is in the clockwise position and the output is terminated with 50Ω.

2.1.16 Amplitude--Vernier

The black knob provides continuous fill-in between ranges of the amplitude range control. When this control is in the fully clockwise position the instrument is calibrated at the setting of the range control.

2.1.17 Pulse Polarity--NEG--OFF--POS

This switch allows the output pulse to be either positive, off, or negative.

2.1.18 Rise Time

This control increases the rise and decay time of the output pulse.
NOTE: On very narrow pulses, increasing the rise time of the output pulse will cause the output amplitude to drop, triggering the overload protect circuit.

2.1.19 Pulse Output

This BNC connector couples the variable parameter pulse to an external load.

2.1.20 Overload

This lamp lights when the output is terminated with low resistive loads or is short circuited or when the duty cycle is exceeded.

2.1.21 Fuse (Located on rear panel)

Three ampere fast blow fuse protects against ac overload.

2.1.22 Power Input (Located on rear panel)

This 3-prong recessed male connector accepts a NEMA 3-wire line cord to supply ac power from the line.

2.2 PLACING IN OPERATION

2.2.1 Preliminary Settings

a) Set REPETITION control to 0.1 Mc/s, VERNIER cw.

b) Set PULSE DELAY control to 0.05μs, VERNIER ccw.

c) Set PULSE WIDTH control to 0.05μs, VERNIER cw.

d) Set RISE TIME control ccw.

e) Set AMPLITUDE to 20 volts, VERNIER cw.

f) Load PULSE OUTPUT with 50 ohms.

g) Set PULSE POLARITY to NEG.

h) Set POWER switch to ON. Pilot should light.

i) Sync scope from SYNC OUTPUT. Set scope sweep speed to 0.1 μs/cm, vertical sensitivity to 10V/cm.

j) View pulse output, comparing it with that shown in Figure 2-1.

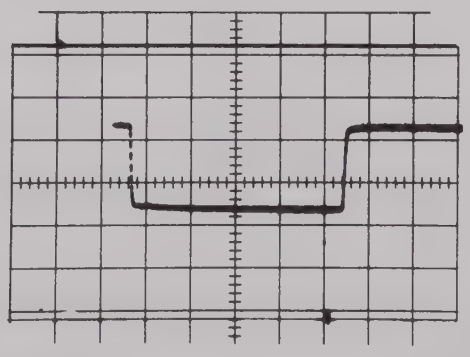


Figure 2-1. NEG Output Pulse With 50 Ohm Load, 0.1 μs/cm, 10V/cm.

k) Switch PULSE POLARITY to POS and view PULSE OUTPUT, comparing it with that shown in Figure 2-2.

l) If instrument fails to function properly, refer to paragraph 4.3.

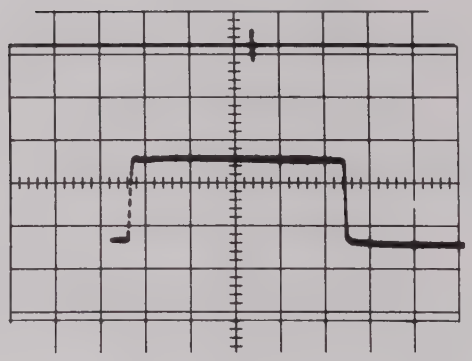


Figure 2-2. POS Output Pulse With 50 Ohm Load, 0.1 μs/cm, 10V/cm.

2.3 OPERATING CONSIDERATIONS

2.3.1 External Triggering

When the repetition rate control is in the EXT - or EXT + position, the Model 108 can be driven from an external source provided that the driving signal is greater than 5V in amplitude and greater than 30 nanoseconds in width. As the synchronizing circuit is a Schmitt trigger with 10 c/s frequency response, the slope and rise time of the driving waveform is not critical. In EXT - position the circuit will trigger on the negative going slope of the input waveform, and in the EXT + position the circuit triggers on the positive going slope.

When externally driving the Model 108, always set the sensitivity control to the full counter-clockwise, or minimum position, before application of the driving waveform. This will insure that no damage will be done to the Schmitt trigger should the driving waveform be greater than ±10V in amplitude. With the external signal applied to the external trigger input jack and the sensitivity control in the minimum position, adjust the sensitivity clockwise until stable triggering is obtained. Do not advance the sensitivity control any more than is necessary as the lowered input impedance and attendant overdrive may cause severe distortion of the input signal which can result in unstable multiple triggering of the Model 108.

WARNING

Always insure that the driving signal is less than ±10V when the sensitivity control is in the maximum (clockwise) position to avoid damage to the Schmitt trigger circuit.

As the input to the synchronizing circuit is ac coupled, the reference level presented will vary as a function of the duty cycle and/or amplitude at the driving waveform. Therefore, when either of these parameters is changed, the sensitivity control must be readjusted to provide triggering at the same point on the input signal.

2.3.2 Duty Cycle Limitations

Average power supply current available limits the maximum pulse width duty cycle of the 108 to 50%. At duty cycles in excess of 50% the power supply will go out of regulation and cause considerable pulse distortion and reduced amplitude, causing the unit to go into overload.

The delay and width controlling one-shot multivibrators have duty cycle capabilities exceeding 70%.

In order to minimize confusion resulting from excessive duty cycle, it is recommended that the delay and width controls be set to their minimum positions when frequency is being changed, and then set to the desired settings upon completion of frequency shift. A common error is to have excessive delay duty cycle without realizing it.

CAUTION

When observing, or making any corrections to the output circuitry (including its power supply), it is necessary that the PULSE POLARITY switch be on OFF or NEG. The unit may be permanently damaged otherwise.

2.3.3 Rise Time Control

This control increases the leading and trailing edge transition times to a maximum of approximately 50 nanoseconds. This slowing down of the output pulse transition times may prove very useful in minimizing the amplitude of impedance mismatch reflections when driving imperfect loads.

2.3.4 Output Amplitude Control

When the vernier control is used to decrease pulse amplitude, the leading edge of the output waveform may change slightly. This does not occur when the amplitude selector is used because step attenuation (2 dB steps) is achieved by means of a series of constant impedance (50 ohm) T-pads; vernier control changes the pulse top clamp voltage for the output amplifiers. Wave shape differences are less apparent when the rise time control is fully counterclockwise (minimum rise and fall time).

2.3.5 Loading Considerations

One of the major advantages of the Model 108 over other pulse generators is its clean waveform at very fast rise time. In order to preserve the high degree of pulse fidelity, it is imperative that due consideration be given to proper pulse termination techniques.

Because of the wide usage of 50 ohm coaxial cables and accessories in industry, the Model 108 was designed for operation with a 50 ohm load.

The output section of the 108 consists of a current amplifier which supplies approximately 5% more current than is required for 50V into 50 ohm. This 5% (approximately 50 mA) is clipped off the pulse top by clamping diodes in order to give extremely flat top pulse characteristics and clean wave shape.

The pulse from the output amplifier is fed through approximately 7 feet of 50 ohm coaxial cable and a 50 ohm attenuator before reaching the output connector.

When the attenuator is set for little or no attenuation, mismatches at the output will cause pulse deformity due to lack of source termination. See Figure 2-4 for typical wave shapes due to improper termination.

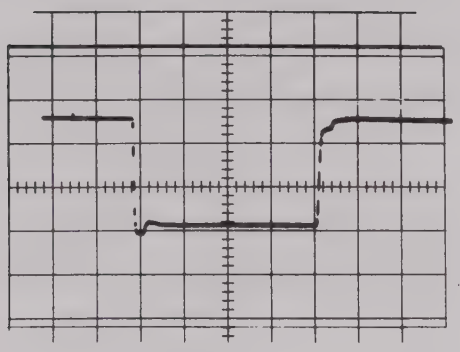
2.3.6 Cabling Considerations

In most cases the Model 108 will be used to drive loads which are physically separated from it by several feet. In this case, it will be necessary to convey the signal by means of a 50 ohm transmission line. Preservation of low distortion waveforms is largely contingent upon the method of cabling and in proper termination of the transmission line. Clean waveforms are maintained by connecting the generator to its load with 50 ohm coaxial cable, and terminating the cable AT THE LOAD into 50 ohms. Figure 2-5 illustrates the effects of poor cabling. Figures 2-6 and 2-7 illustrate proper cabling.

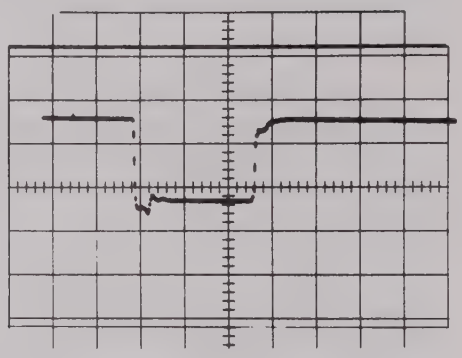
2.3.7 Mixing of Outputs of Several Model 108 Generators

As shown in Figure 2-8 the upper and lower levels of the output pulse are clamped; this indicates that without any attenuation between the output pulse and the output jack, the maximum excursion of external pulses is limited to these voltages. In other words only pulses of the same polarity may be mixed without previous pulse attenuation. Pulses of both polarities may be mixed when 10 dB or more of attenuation is inserted, providing a source termination of nearly 50 ohms at the generator. Caution should be taken not to exceed the output attenuator power dissipation capabilities. Looking back into the attenuator at voltage settings of 5 volts and below, the dissipation capability is approximately 4 watts.

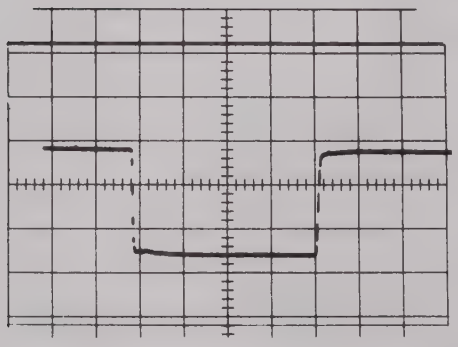
Photographed from Tektronix Type 661
Sampling Oscilloscope
100 nanosec/cm; 20V/cm.



A. Full Amplitude Neg. Pulse Loaded With 62 Ohms at the Output Connector.



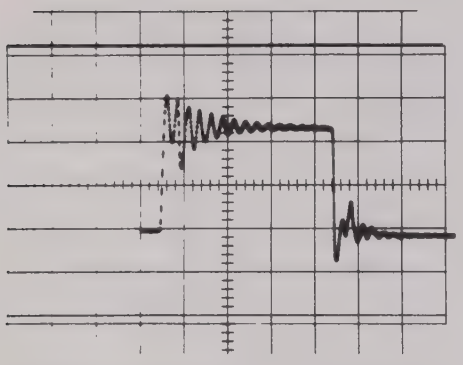
B. Full Amplitude Neg. Pulse Loaded With 39 Ohms at the Output Connector.



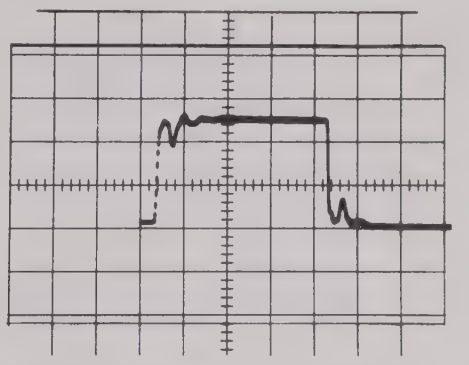
C. Full Amplitude Neg. Pulse Loaded With 50 Ohms.
Note absence of overshoot and step at pulse trailing edge.

Figure 2-4. Output Pulse Showing Proper and Improper Loading.

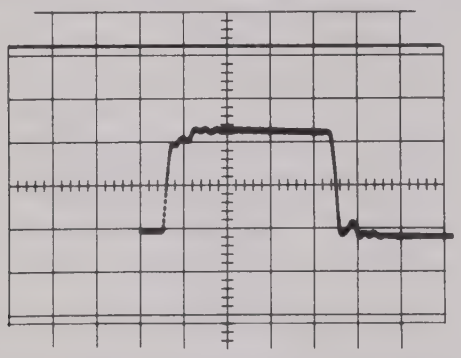
All photos were taken using a Tektronix Type 661 Sampling Oscilloscope with vertical sensitivity set at 20V/cm.



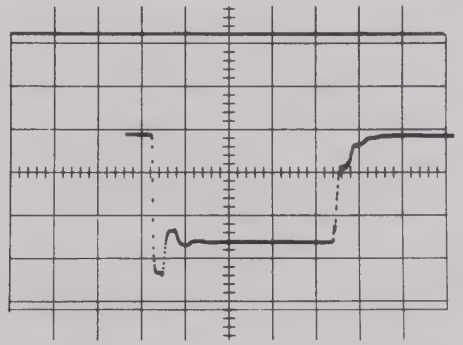
A. Pos. Output at the End of 4 ft. of RG58A/U Cable Terminated With 50 Ohms at the Generator (0.1μs/cm).



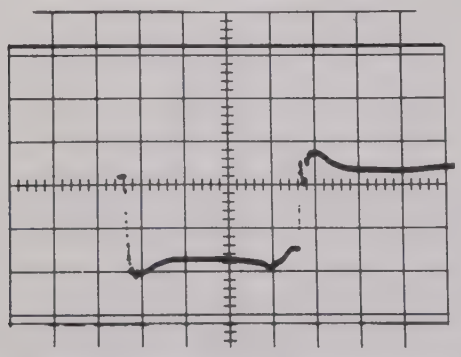
B. Pos. Output at the End of 4 ft. of RG63/U 93Ω Cable Terminated With 50 Ohms at the Oscilloscope (0.1μs/cm).



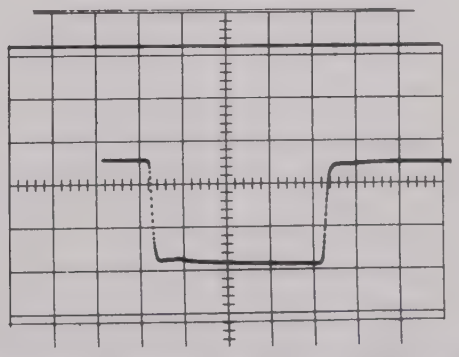
C. Pos. Output Under the Same Conditions as (A), Except Rise Time Control on Generator Turned cw (0.1μsec/cm).



D. Neg. Output Viewed at the Output Jack With a 100Ω Load. (Reflection due to 6 to 8 ft. Length 50Ω Coax Inside the Generator.) (0.1μs/cm)



E. Neg. Output at the End of a 4 ft. Clip Lead, Terminated With 50 Ohms at Oscilloscope (0.5μsec/cm).



F. Neg. Pulse Through 4 ft. RG58A/U Cable, Terminated Into 50 Ohms at Oscilloscope (Proper Technique) (50ns/cm).

Figure 2-5. Output Pulses Showing Effects of Improper Cabling Techniques.

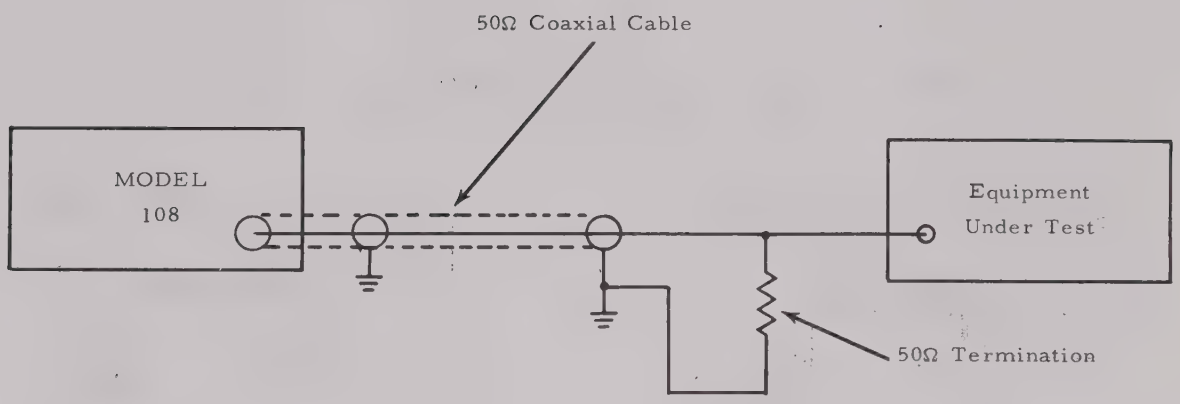


Figure 2-6. Proper Cabling Connection for Driving External Equipment.

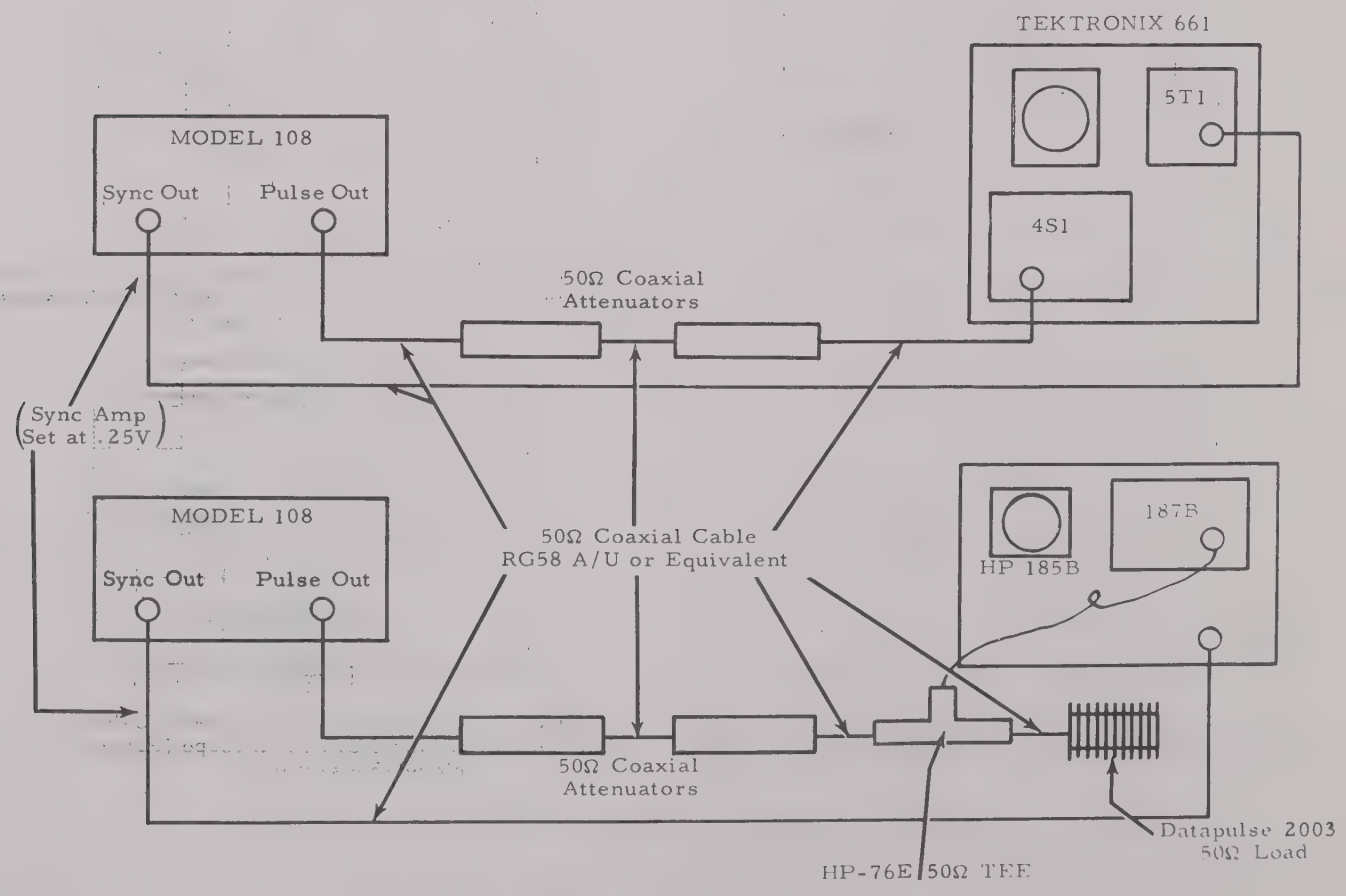


Figure 2-7. Methods of Observing Pulse Output on High Frequency Sampling Scopes.

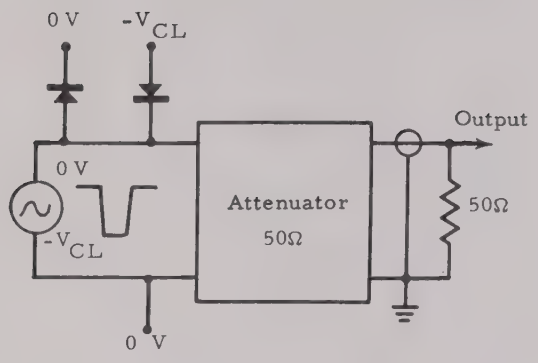


Figure 2-8
Simplified Output Circuit Schematic.

CAUTION

When observing, or making any connections to the output circuitry, including its power supply, it is necessary that the PULSE POLARITY switch be on OFF or NEG. The unit may be permanently damaged otherwise.

2.3.8 Overload Operation When Operating With Narrow Pulses

On very narrow pulses, increasing the rise time of the output pulse will cause the amplitude to drop, triggering the overload protect circuit.

2.3.9 Ventilation Requirements

The cooling fan and air filter are located on the rear panel of the Model 108. Leave adequate clearance (at least 2 to 3 inches) behind and at both sides of the instrument for free movement of air. The path of air flow is through the filter and intake fan then out of the perforated side covers. It is important to keep the air intake area free of dust and small particles which could clog the filter.

2.4 SPECIAL APPLICATIONS

2.4.1 Multiple Pulse or Pulse Train Operation Using Several Model 108's (For mixing considerations read 2.3.7)

Magnetic device testing, beacon development, and digital or other pulse code simulation often require multiple pulse or pulse train signals. Multiple Datapulse 108 Pulse Generators, when properly connected, will satisfy a broad range of requirements of this type.

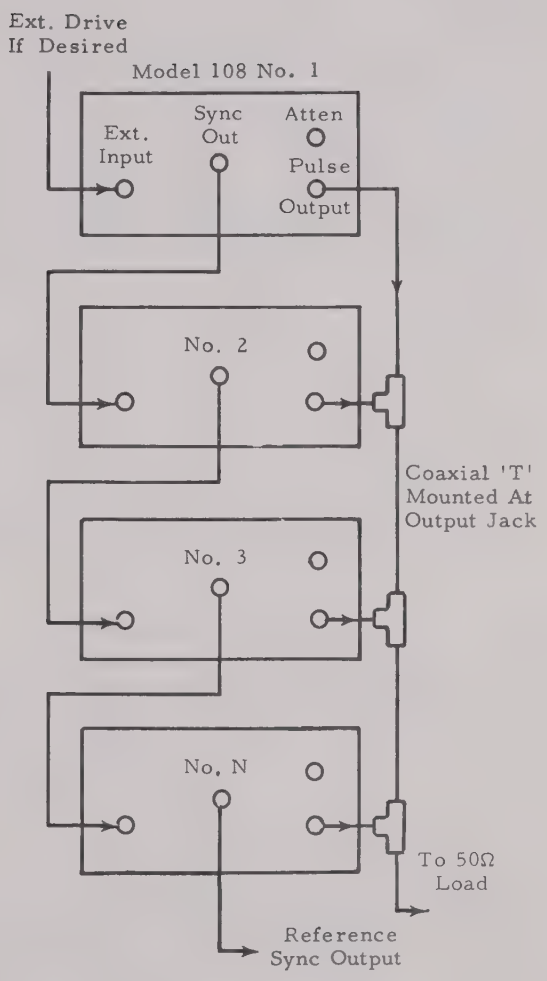


Figure 2-9
Wiring for Multiple Pulse Output.

NOTE: Sync occurs approximately 0.13 μs after EXT trigger. Reference sync will occur N x 0.13 μs after external trigger if N equals the number of generators.

2.4.1 (continued)

Mixing the outputs of several 108's, instead of purchasing a special purpose multi-pulse generator, offers many advantages. First, pulse parameters may be controlled individually; second, all pulses are selectable in polarity--a feature not always available on multi-pulse generators; third, such an arrangement is more versatile since the individual units may be broken down for use on other projects; and fourth, the combination of simple, proven, easily operated 108's is more dependable than complex special gear.

The 108's may be driven in parallel from an external source, if sync with outside phenomena is desired, or driven in tandem (see Figure 2-9) using the sync output of one generator to externally drive the next. The first generator may be driven from an external source in the tandem arrangement also. Because of the fast rise character of the pulses and narrow widths available, pulse repetition rates approaching 50 Mc may be synthesized.

The termination of interconnecting cables has an important effect on output waveform in this arrangement. Improper termination causes reflections which deteriorate wave shape and increase the rise time. However, good waveform fidelity can be obtained by inserting some measure of attenuation (the amount varying with the number of generators) at the generator end with the internal attenuator. The 50Ω output impedance of the attenuator tends to terminate the interconnecting cables. The greatly decreased waveform distortion more than offsets the slight loss of amplitude sustained. (See Section 2.3.7)

SECTION III
THEORY OF OPERATION

3.1 BLOCK DIAGRAM DESCRIPTION (Figure 3-1)

3.1.1 Pulse Generating Circuit

A pulse repetition rate (W1) is developed by the internal oscillator. Either this signal or an external trigger input is applied to the Schmitt trigger circuit which provides a standardized trigger (W2). W2 is delayed 130 nanoseconds and amplified to become the sync output pulse (W4) which is used as a zero time reference for the pulse delay function. W2 is amplified by the clock driver, provided the external gate input allows it, and triggers the delay one-shot multivibrator which produces the delay gate (W5). The trailing edge of W5 is differentiated by a pick-off amplifier yielding the delayed trigger (W6). The delayed trigger (W6) triggers the width one-shot pro ducing the width gate (W7). The trailing edge of W7 is differentiated by a pick-off amplifier yielding W9, the trailing edge trigger. W5 is delayed and differentiated producing W8, the leading edge trigger. W9 and W8 are used to trigger the pulse forming flip-flop. The flip-flop produces W10 which drives the output power amplifier. The power amplifier transforms W10 into high power pulse W11 which may be attenuated by a constant impedance attenuator to a desired level to produce W12.

The flip-flop and output amplifier are isolated from the front end circuitry by means of trigger coupling transformers. Either positive or negative output pulses are obtained by a reversing switch on the output leads.

3.1.2 Overload Protection Circuit

Protection circuits turn the overload lamp on and block the pulse forming circuits to protect the output transistors when the output is overloaded. W13 occurs simultaneously with W10 when leading edge trigger W8 turns the flip-flop on, but W14 is delayed so that output sample W15 is applied to the comparing circuit first. During normal operation, W15 inhibits W14 and the flip-flop is turned off at the end of the pulse by W9. Under overload conditions that cause W11 to drop below 40 volts, W15 does not occur and W14 triggers a reset signal that prematurely returns the flip-flop to its off state.

When the output is overloaded, the inhibit signal that normally blocks W17 at its AND gate is removed and the protection multivibrator is triggered by W18 when trailing edge trigger W9 occurs. This turns the overload lamp on and applies an inihibit signal to both the leading and trailing edge AND gates. Thus the input to the pulse forming flip-flop is blocked when overload conditions exist, and the block is automatically removed when the multivibrator returns to its stable state after approximately two seconds.

CAUTION

When observing, or making any connections to the output circuitry, including its power supply, it is necessary that the PULSE POLARITY switch be on "OFF" or "NEG". The unit may be permanently damaged otherwise.

3.2 CIRCUIT DESCRIPTIONS

3.2.1 Internal Oscillator (Figure 3-2)

The internal oscillator is an emitter coupled RC oscillator which functions as follows:

Assume Q2 has just begun to conduct, its collector goes negative. This signal on the base of Q3 drives its emitter negative. The negative signal at the emitter of Q3 is coupled across C_t to the emitter of Q2 causing conduction to increase. The increase of conduction through Q2 causes its collector to go more negative, regeneratively driving Q2 toward saturation until the clamp voltage of the anode of CR1 is reached. C_t charges through Q2, R6, and R10. As C_t becomes charged to the signal voltage, its contribution to the current through R6 will decrease. As the current through R6 decreases, the collector of Q2 moves positive. This positive going signal on the base of Q3 causes the emitter of Q3 to move positive and the positive going waveform is coupled across C_t to the emitter of Q2 decreasing conduction. As conduction of Q2 decreases, its emitter becomes more positive regeneratively cutting off Q2. C_t now discharges through R_t and Q3. When C_t has discharged down to the level set at the base of Q2, Q2 will again begin to conduct and the cycle will be repeated. The negative spike at the collector of Q2 is emitter-follower coupled to the Schmitt trigger circuit by Q4. Q1 provides a low impedance clamp voltage for CR1.

3.2.2 Schmitt Trigger Circuit (Figure 3-3)

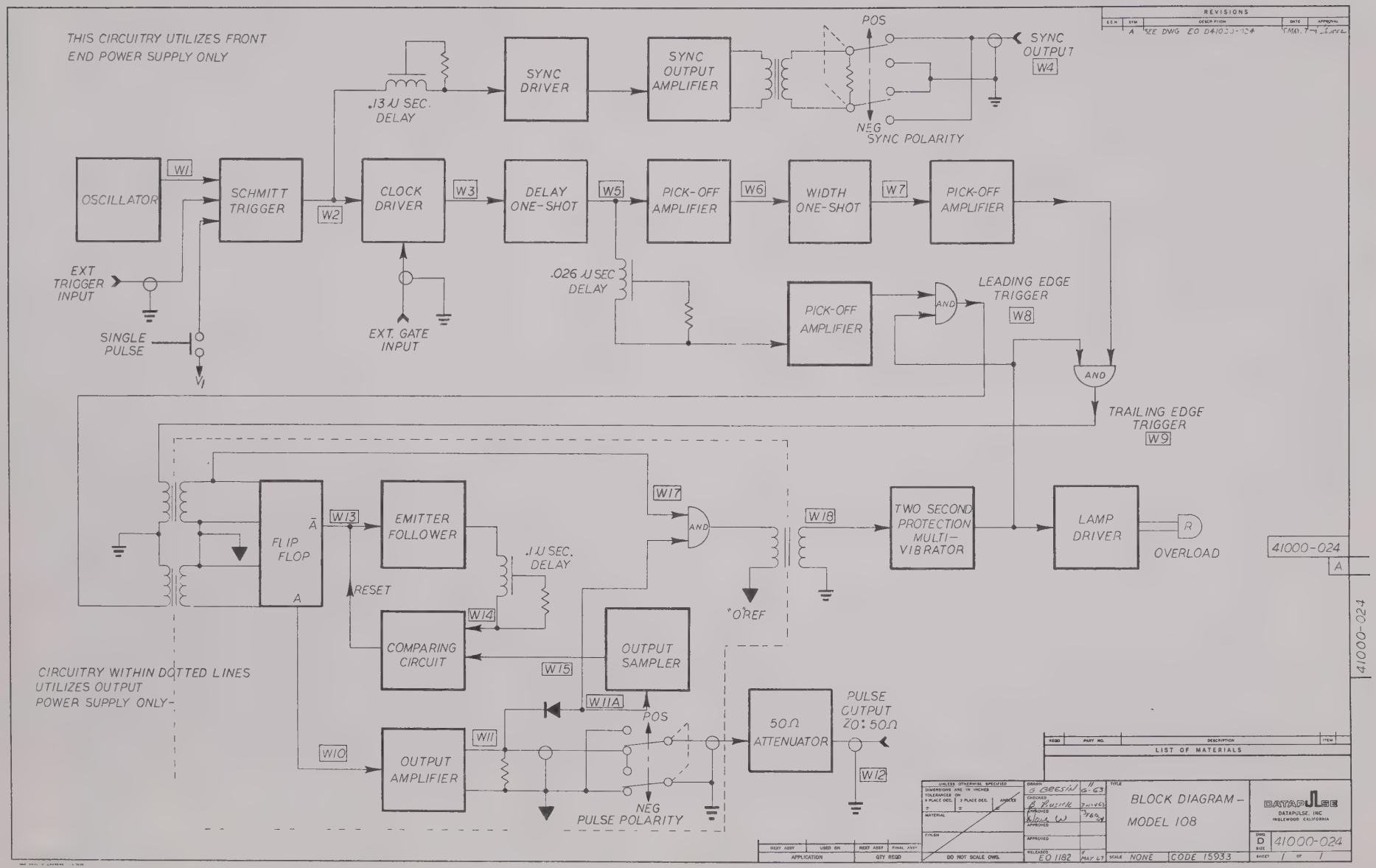
The Schmitt trigger is used to standardize waveforms either from the internal oscillator or tne external input having varying wave shape. Because of regeneration during switching, the output of the Schmitt circuit has relatively constant rise time regardless of input wave shape. The operation is as follows:

Initially Q5 is conducting. Both the emitter of Q5 and the emitter of Q6 are approximately at the base potential of Q5 which is set by the voltage divider composed of R12, R13, and R14. The collector of Q5 is clamped by CR2 to another point on the divider. The base of Q6 is set by the divider consisting of R18 and R19 to a point more negative than its emitter. Therefore, Q6 is cut off.

Negative going signals at the base of Q5 turn Q5 off and allow its collector to go positive. Q6 is turned on by the positive going waveform coupled to its base by C14 and R18, and the common emitters follow the positive going base of Q6. Q5 is cut off sharply by its positive going emitter and Q6 is regeneratively turned on. When the applied pulse subsides, Q5 turns on and the negative going waveform at its collector is coupled to the base of Q6 to regeneratively restore the circuit to its quiescent state.

Positive going inputs initiate switching at the base of Q6 and the rest of the cycle is similar to that for negative triggering.

Output of the circuit is taken from the collector of Q6.


THIS CIRCUITRY UTILIZES FRONT END POWER SUPPLY ONLY
REVISIONS
ECN SYM DESCRIPTION DATE APPROVAL
A SEE DWG EO D41000-024 FMD. T-4 SHEET
.13 μ SEC. DELAY
SYNC DRIVER
SYNC OUTPUT AMPLIFIER
POS
NEG SYNC POLARITY
SYNC OUTPUT
W4
OSCILLATOR
W1
SCHMITT TRIGGER
W2
CLOCK DRIVER
W3
DELAY ONE-SHOT
W5
PICK-OFF AMPLIFIER
W6
WIDTH ONE-SHOT
W7
PICK-OFF AMPLIFIER
EXT TRIGGER INPUT
SINGLE PULSE
V1
EXT. GATE INPUT
.026 μ SEC DELAY
PICK-OFF AMPLIFIER
AND
LEADING EDGE TRIGGER
W8
AND
TRAILING EDGE TRIGGER
W9
FLIP FLOP
Ā
A
W13
EMITTER FOLLOWER
.1 μ SEC. DELAY
RESET
W14
COMPARING CIRCUIT
W15
OUTPUT SAMPLER
W17
AND
W18
"0" REF
TWO SECOND PROTECTION MULTI-VIBRATOR
LAMP DRIVER
R
OVERLOAD
41000-024
A
CIRCUITRY WITHIN DOTTED LINES UTILIZES OUTPUT POWER SUPPLY ONLY
W11A
POS
W11
W10
OUTPUT AMPLIFIER
NEG PULSE POLARITY
50Ω ATTENUATOR
PULSE OUTPUT ZO: 50Ω
W12
REQD PART NO. DESCRIPTION ITEM
LIST OF MATERIALS
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON X PLACE DEC. ± X PLACE DEC. ± ANGLES ± MATERIAL FINISH
DRAWN G GRESH 11-63
CHECKED R RUSSELL 7 NOV 63
APPROVED Klaus W 7 NOV 63
APPROVED
RELEASED EO 1182 MAY 67
TITLE BLOCK DIAGRAM - MODEL 108
DATAPULSE DATAPULSE, INC INGLEWOOD CALIFORNIA
SIZE D 41000-024
SCALE NONE CODE 15933
SHEET 1 OF 1
NEXT ASSY USED ON APPLICATION
NEXT ASSY FINAL ASSY QTY REQD
DO NOT SCALE DWG.
41000-024

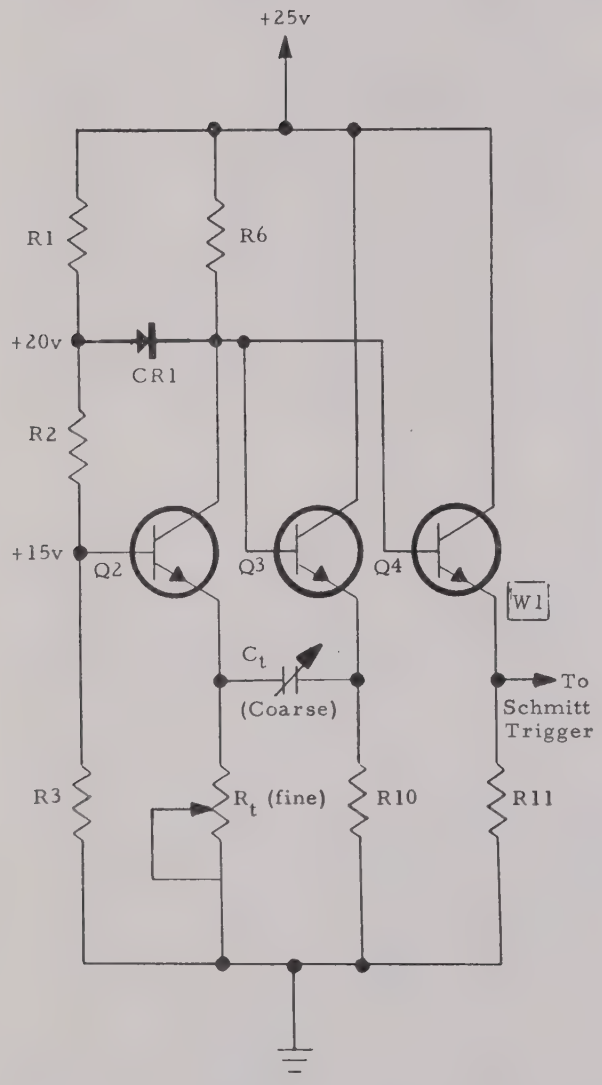


Figure 3-2. Simplified Internal Oscillator.

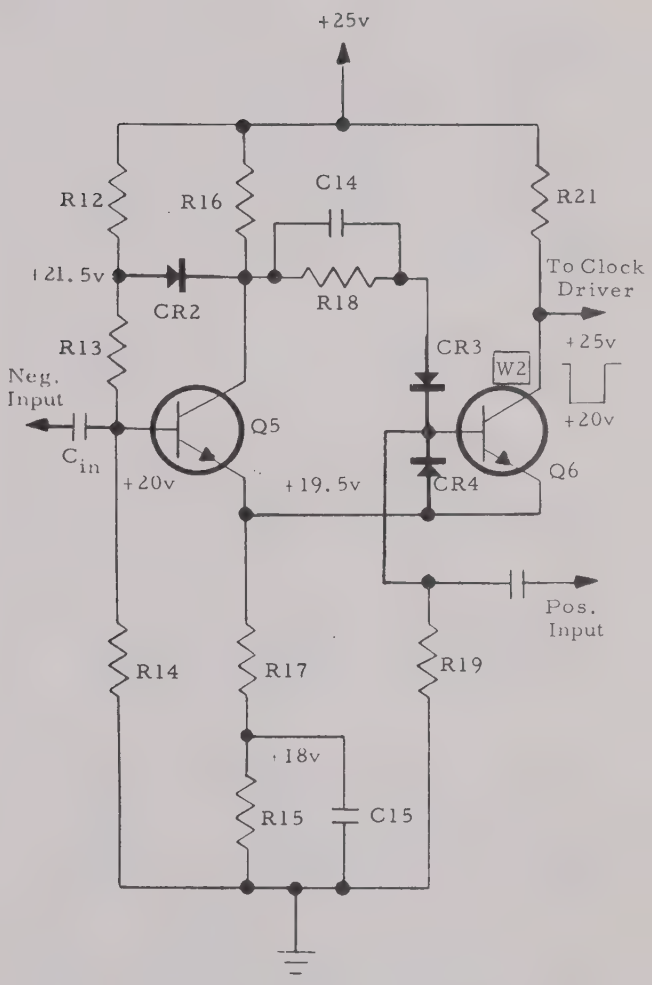


Figure 3-3. Simplified Schmitt Trigger.

3.2.3 One-Shot Multivibrator (Figure 3-4)

The pulse delay circuitry is an emitter coupled one-shot multivibrator. As pulse width is essentially a delay function (i.e., the delay of trailing edge with respect to leading edge), the same technique is used to perform both operations. The circuit functions as follows:

In the static state Q15 is held on by the bias developed across CR73 and CR75. The collector of Q15 is clamped at approximately -4V by CR74. Upon the application of a negative trigger at the base of Q15, Q15 is turned off and its collector rises toward +25V, but is clamped at ground by CR76. This positive step is emitter-follower coupled to C_t by Q16, coupled across C_t and through emitter followers Q17 and Q18 back to the emitter of Q15. C_t now begins to charge through R_t, R76, and Q16. When C_t has charged to the signal voltage, Q15 again begins to conduct. The collector of Q15 drops back to the -4V clamp level and C_t discharges through R75, R76, and CR77.

Output is taken from the collector of Q15. This gate is delivered to the pick-off amplifier to obtain leading or trailing edge output pulse triggers.

3.2.4 Pick-Off Amplifier (Figure 3-5)

The pick-off amplifier uses a noninverting transformer (T81 and T140) to differentiate the gate produced by the delay and width one-shot multivibrators. Its operation is as follows:

Initially, steady state current flows in Q19 and the primary of T81. The base of Q20 is biased at -5V. As Q20 is an emitter follower, its emitter is at approximately -5V and holds Q21 cut off. The collector of Q21 is clamped at ground by CR81.

At the initiation of the input gate, the base of Q19 is driven positive increasing conduction. This causes its collector to go negative as a magnetic field builds up in T81. The negative going signal is applied to the base of Q20 and then to the base of Q21. As Q21 is already cut off no change takes place in its collector circuit. The magnetic field in T81 is soon built up and the negative pulse subsides.

At the termination of the input gate, the negative going trailing edge causes current in Q19 to decrease and the field in T81 collapses causing a positive spike at the base of Q20. This positive spike is coupled to the base of Q21. Q21 then conducts driving its collector sharply negative, producing a negative delayed trigger.

3.2.5 Output Amplifier and Pulse Forming Circuitry (Figure 3-6)

The output amplifier driving pulse is formed through the use of a bistable multivibrator which is triggered by the leading and trailing edge triggers from the pulse width and delay one-shot multivibrators. The formed pulse from the bistable circuit is amplified by several stages of emitter followers, complimentary emitter followers and one inverter to raise the voltage of the pulse.

The output transistors are in the common-base configuration and would be driven slightly into saturation except for the use of clamp diodes which limit the collector-to-base voltage to approximately 4V. If the clamp diodes were not used, storage effects caused by the relatively high T_s in the output transistors would distort the output pulse considerably. A simplified circuit description of the output is as follows (Refer to Figure 3-6).

In the static state the emitter of Q1 is more positive than $-V_b$ by the drop across CR1 and V_{be} Q1. This places the emitter of Q2 more positive than its base and therefore, in a cutoff condition. Upon the application of a negative signal to the base of Q1, the base emitter diode of Q2 is forward biased, and a current of magnitude $\frac{\text{E signal}}{\text{R emitter}}$ flows in the emitter of Q2. A current of Alpha (approximately 0.95 to 0.98) times the emitter current flows in the collector of Q2 and through the load R_1. As the negative input pulse subsides, the circuit reverts to the static state. The clamp voltage ($-V_{c1}$) limits the amplitude of the output pulse and is varied approximately 20% to provide the continuous fill-in between the constant impedance attenuator voltage settings.

3.2.6 Reversing Pulse Polarity (Figure 3-6)

Pulse polarity is reversed by merely reversing the connections between the center conductor and shield of the coaxial cable carrying the pulse. Polarity switch S390 performs this function. This method of reversing polarity is possible because a floating power supply is used allowing the ground reference to be established at any level. Negative pulse outputs occur when the collectors of the output transistors drive the center conductor of the 50Ω coax and the 0V reference is tied to the shield. Positive pulses occur by reversing these connections and placing the 0V reference at the center conductor. The capacity of the 0V reference ▼ to the instrument chassis would load the positive polarity pulse were it not for the balun choke (L390) effectively isolating this capacity from the chassis. The 0V reference capacity to the chassis is kept at a minimum through the use of a low capacity power transformer T400 and careful circuit layout.

3.2.7 Pulse Forming Reset Circuit Description (Figure 3-7)

Under normal conditions W11A is formed by the clipping action of CR331 and CR332. This pulse is fed through Q313, Q312, Q311, and to the base of Q310. W16 is somewhat wider than W11A due to the biasing of Q311 and the slow fall time of W15. Q310 is normally biased on but is off during the time W16 is positive. W13 is fed through DL330 and will turn itself off after 0.1 microsecond if W16 is not positive by that time. In other words, after the initial 0.1 microsecond delay of DL330, if W11 drops below 40 volts, W11A will drop to -40V and W16 will go negative causing Q310 to conduct through Q309, which is already on, returning W13, and therefore, the current drive to the output, to its "OFF" state.

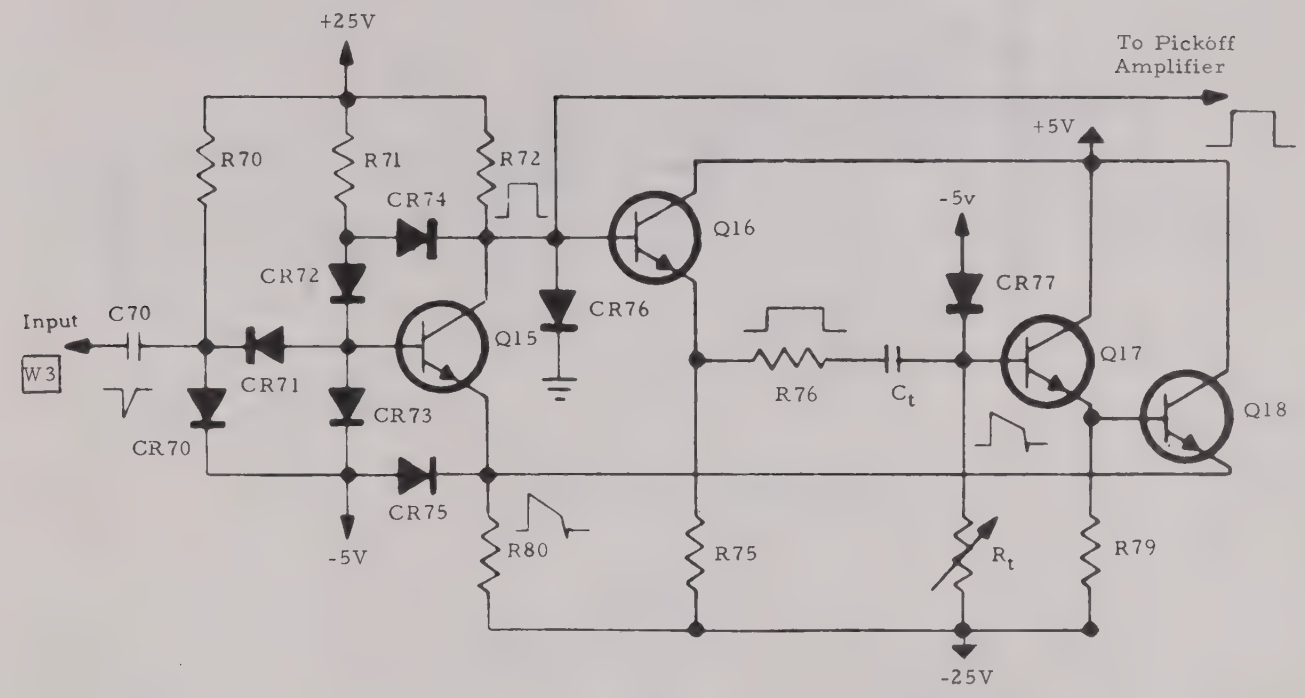


Figure 3-4. Simplified One-Shot Multivibrator.

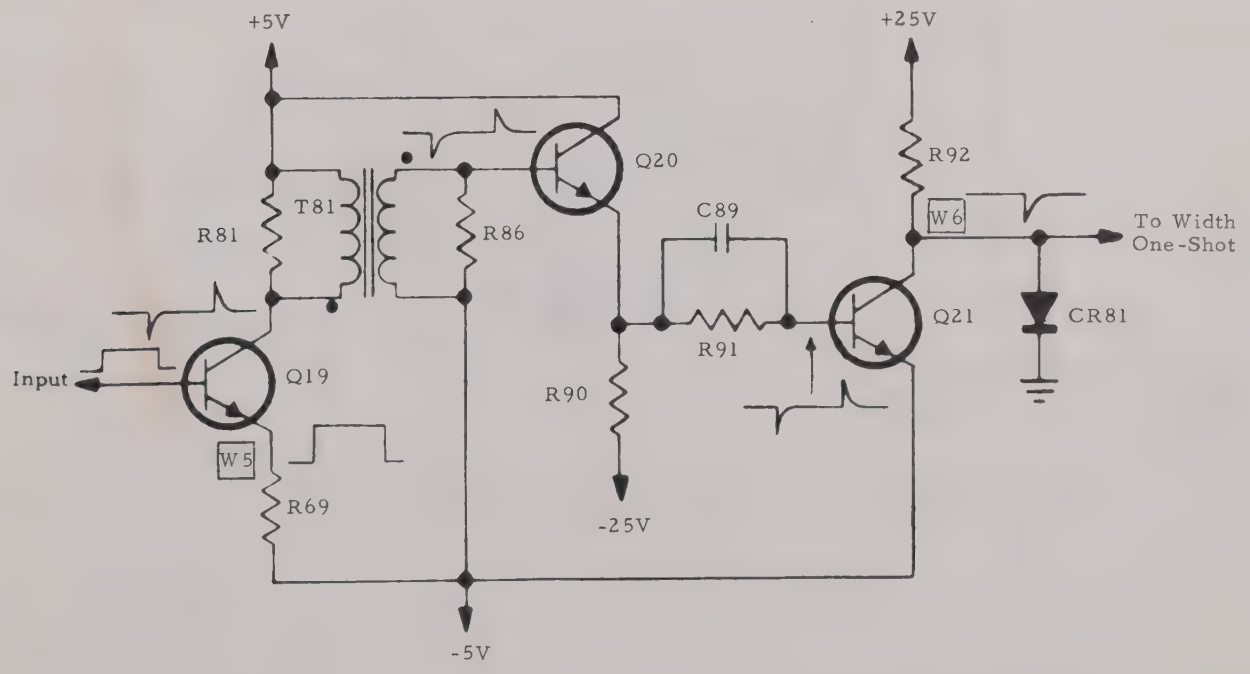


Figure 3-5. Pickoff Amplifier.

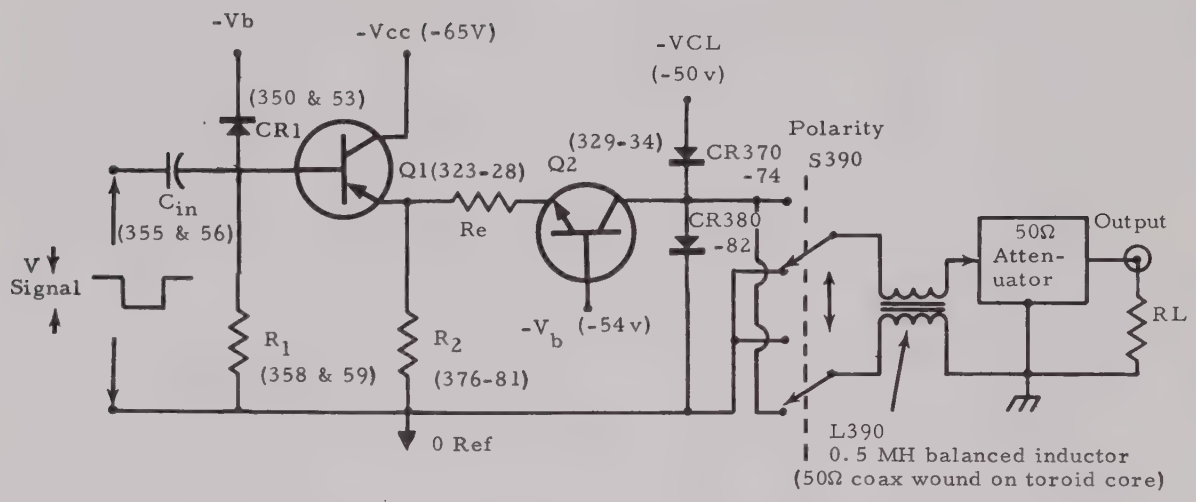


Figure 3-6. Simplified Output Circuit.

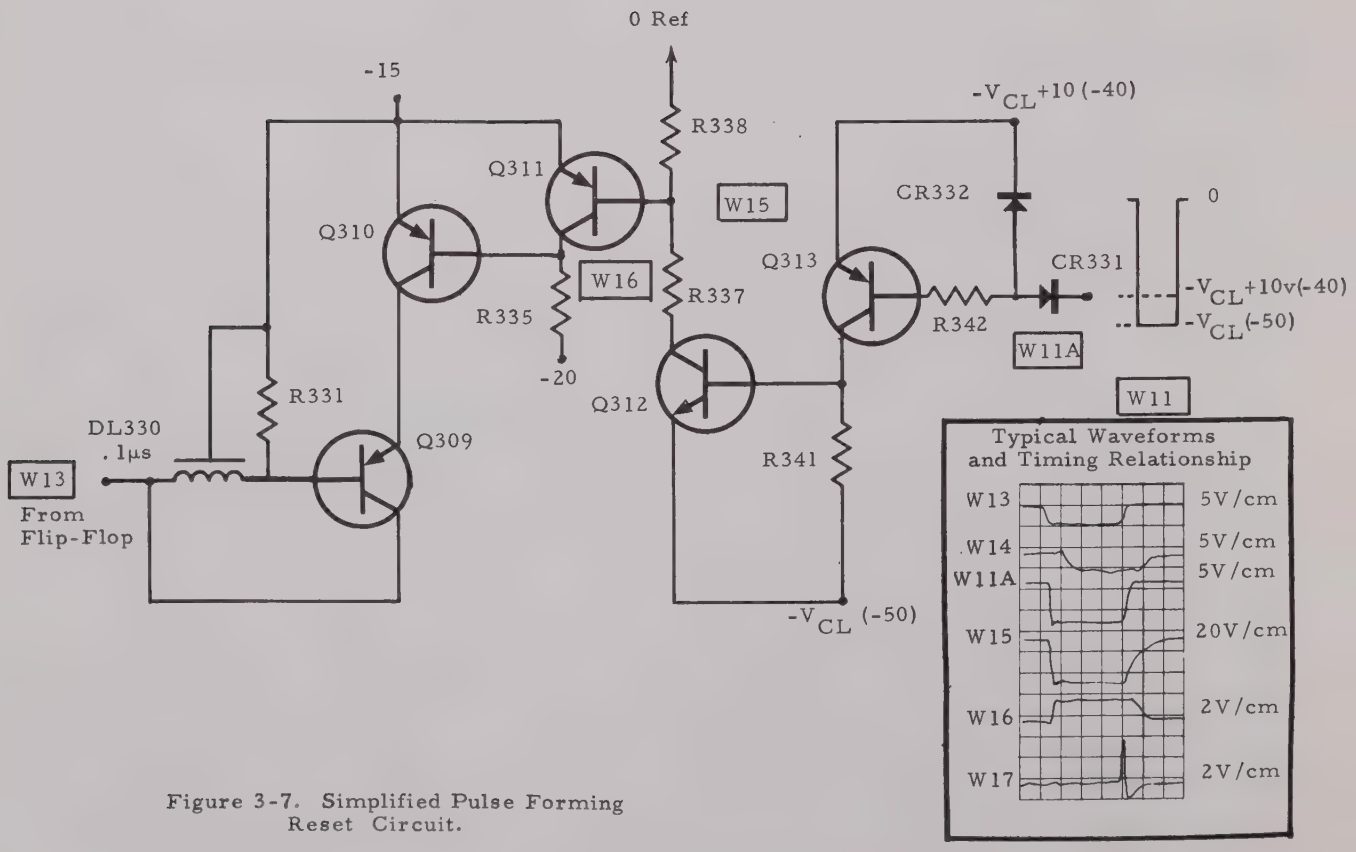


Figure 3-7. Simplified Pulse Forming Reset Circuit.

3.2.8 Trigger Hold Off and Overload Lamp Indicator Circuit Description (Figure 3-8)

Under normal conditions this circuitry is inoperative due to W11A biasing off Q307 when the output is operating.

When the output drops below 40 volts, due to overload, W11A returns to -40 volts causing Q307 to be biased on. The next trailing edge trigger W17 which occurs will cause Q306 to conduct through Q307, forming W18. W18 triggers a two-second multivibrator which supplies gate for holding off all leading and trailing edge triggers and drives a front panel overload indicator lamp.

The two-second multivibrator is actually two multivibrators in tandem, allowing for immedate reset in case of prolonged overloads.

NOTE: On very narrow pulses, increasing the rise time of the output pulse will cause the output amplitude to drop, triggering the overload protect circuit.

CAUTION

When observing, or making any connections to the output circuitry , including its power supply, it is necessary that the PULSE POLARITY switch be on "OFF" or "NEG". The unit may be permanently damaged otherwise.

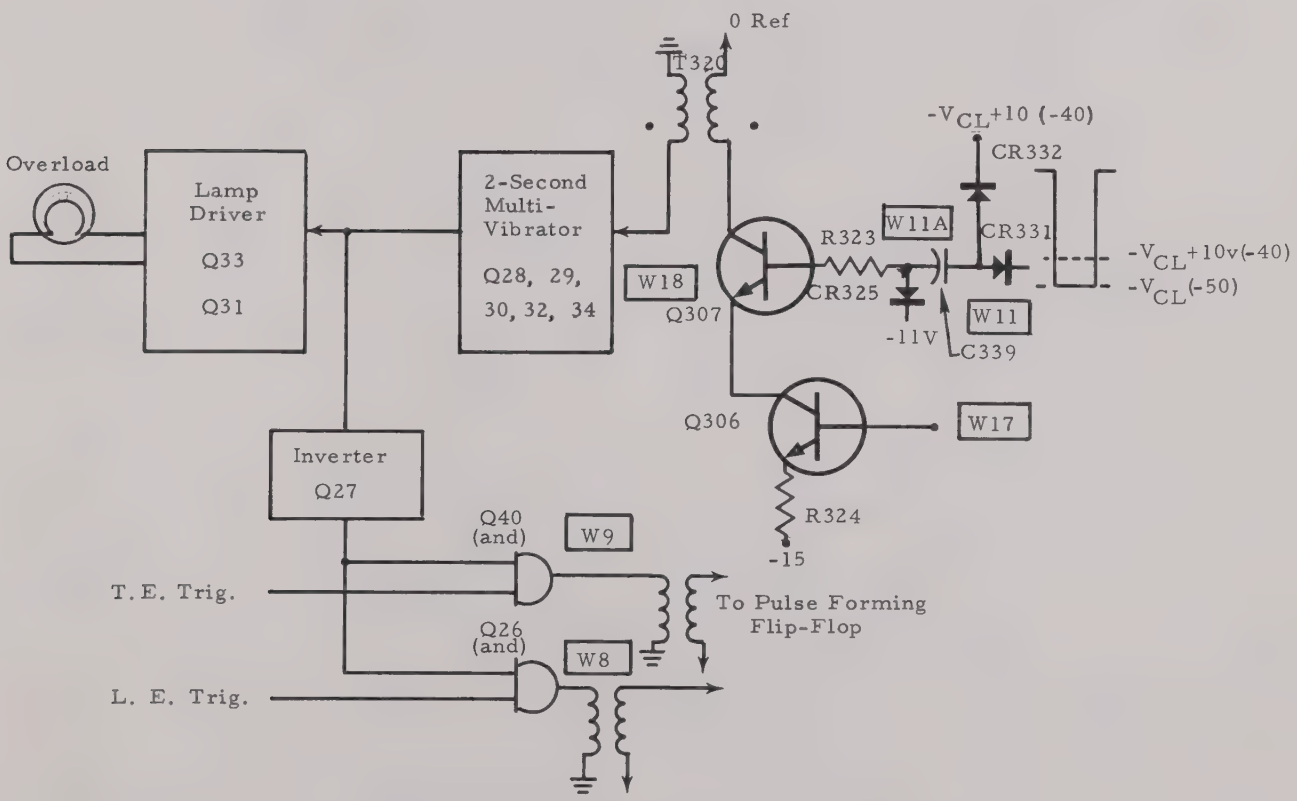


Figure 3-8. Simplified Trigger Hold-Off and Overload Lamp Circuit.

MAINTENANCE INSTRUCTIONS

4.1 PREVENTIVE MAINTENANCE

4.1.1 Preventive Inspection and Service

Inspection and service of a preventive nature will result in optimum performance and longer life of this instrument. Dust covers should be removed at regularly scheduled intervals to permit inspection for dust, tarnish, corrosion, loose nuts and bolts (especially those serving as electrical conductors), loose cables and fuses, charred insulation, scorched resistors and broken wiring. Discoloration of the printed circuit board, due to heat, does not affect the board's electrical properties and may be disregarded in most cases.

4.1.2 Minor Repairs

The operator should be thoroughly acquainted with the instrument's circuit theory and component location before attempting repair. In all cases, setting and adjustment of controls should be checked in order to verify that difficulties encountered are actually caused by malfunction and not by operation outside of specifications. Check transistors in suspected circuits prior to conducting extensive tests on other components.

4.1.3 Recalibration

This instrument was designed to provide maximum reliability and stability. To insure that accuracy remains within stated limits, we suggest that calibration be checked after every 200 hours of operation. See Section 4.5 for calibration check. If the unit is used intermittently, calibration should be checked every three months. Complete instructions for calibration are given in this manual.

4.2 PARTS REMOVAL AND REPLACEMENT

4.2.1 General

This instrument is sturdily built and easily accessible. Removal of most parts is so simple that explanations are unnecessary. However, some parts are more easily removed if a definite procedure is followed. Replacement of some parts will also require partial recalibration. Refer to Section 4.4 of this manual for calibration instructions.

4.2.2 Removal of Dust Covers

The dust covers are held in place by small screw-head fasteners. To remove, turn the fasteners a quarter turn counterclockwise with a common screwdriver. To remove the top dust cover: (1) loosen the four fasteners on the sides of the top dust cover; (2) loosen the two fasteners on the top; and (3) lift the cover off.

To remove the bottom dust cover: (1) turn the instrument upside down; (2) loosen the four fasteners on the bottom of the cover; and (3) lift the cover off.

4.2.3 Replacement of Power Transistors

The power transistors which are mounted to the rear panel must have a thin film of silicon grease (such as Dow-Corning DC-4) applied to their common contact surfaces.

4.2.4 Soldering Considerations

Although printed wiring is quite vulnerable to heat excesses, a great deal of resoldering can be done on a single joint if care is taken. A 35-watt wedge tip or pointed tip iron and 60-40 rosin core solder are quite effective. Where both sides of the board are accessible apply the tip of the iron (on the side opposite the component) directly to the solder fillet and pull gently on the pigtail with pliers from the opposite side. Where both sides of the circuit board are not accessible, the component lead will be fed through the board through an eyelet. Apply the iron tip to the eyelet and pull the pigtail out with the pliers. To insert a new component, clean out the hole with a sharp object (it may be necessary to apply more heat) and insert the new component, soldering in the old place.

4.3 TROUBLESHOOTING PROCEDURE

Before any troubleshooting is attempted, the front panel controls should be checked for proper setting. You may wish to refer to paragraph 2.3, "Operating Considerations" which details many of the limitations of the instrument and describes the performance to be expected. After you have ascertained that a trouble does exist, you may continue according to the procedures outlined in this section.

Many apparent malfunctions are due to improper calibration of one or more of the circuits, and often a transistor is replaced that required recalibration. If you suspect that a circuit is miscalibrated, refer to Section 4.5 of this manual which describes a procedure for determining calibration status. Section 4.4 provides a detailed calibration procedure.

Whenever trouble occurs, check the power supply voltages. This test may be done by following paragraph 4.4.3 of the "Calibration Procedure". It may be assumed that the power supplies are functioning properly if the output and ripple voltages are correct.

When malfunction can be attributed to a particular circuit, perform a complete visual inspection in that area. See Figure 4-1 for the location of circuits. Frequently, visual inspection reveals the effects of the trouble (such as burned resistors) rather than the cause. However, these effects may give clues as to the actual cause. Care should be taken to find the real cause.

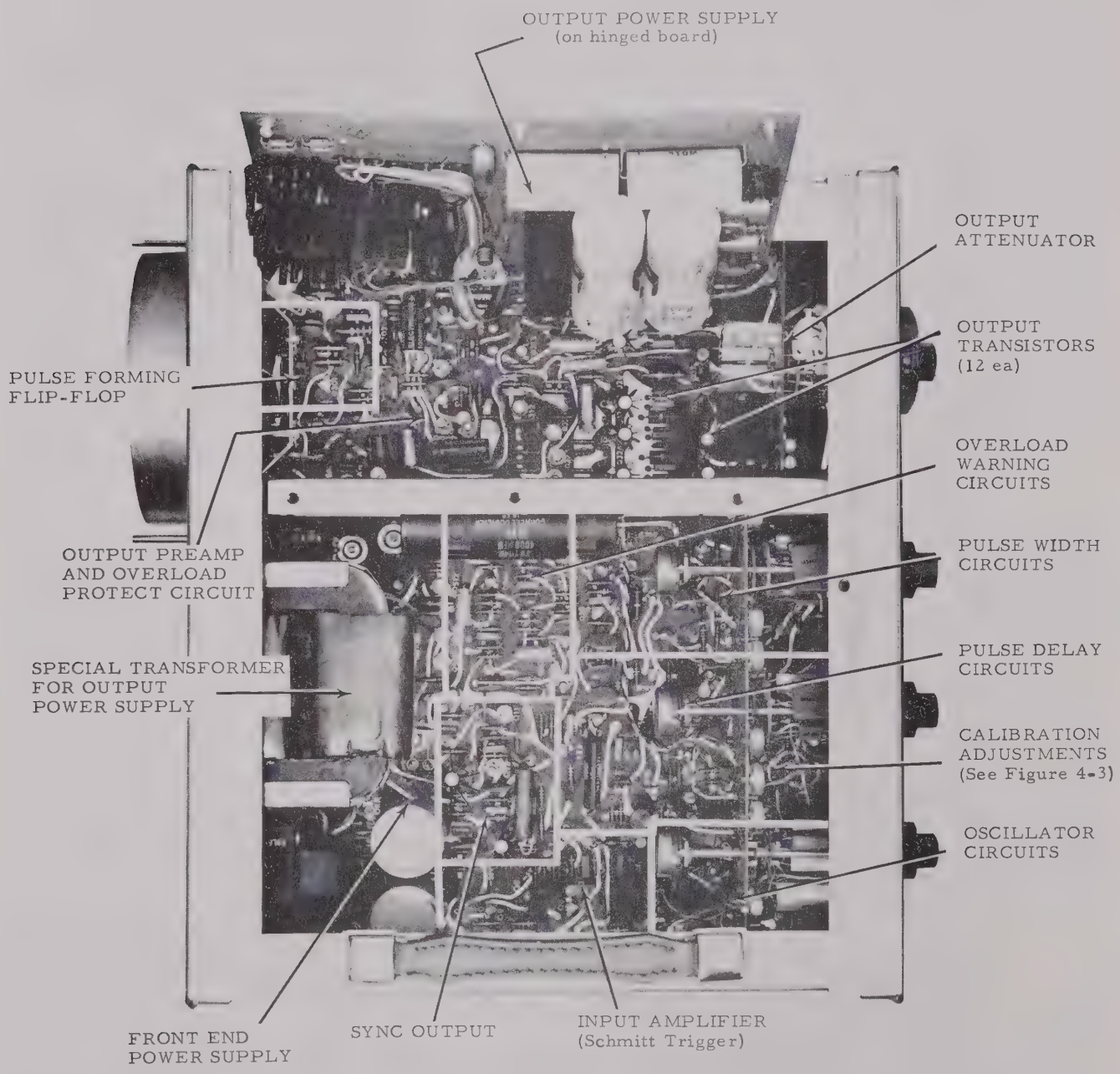


Figure 4-1. Circuit Locations.

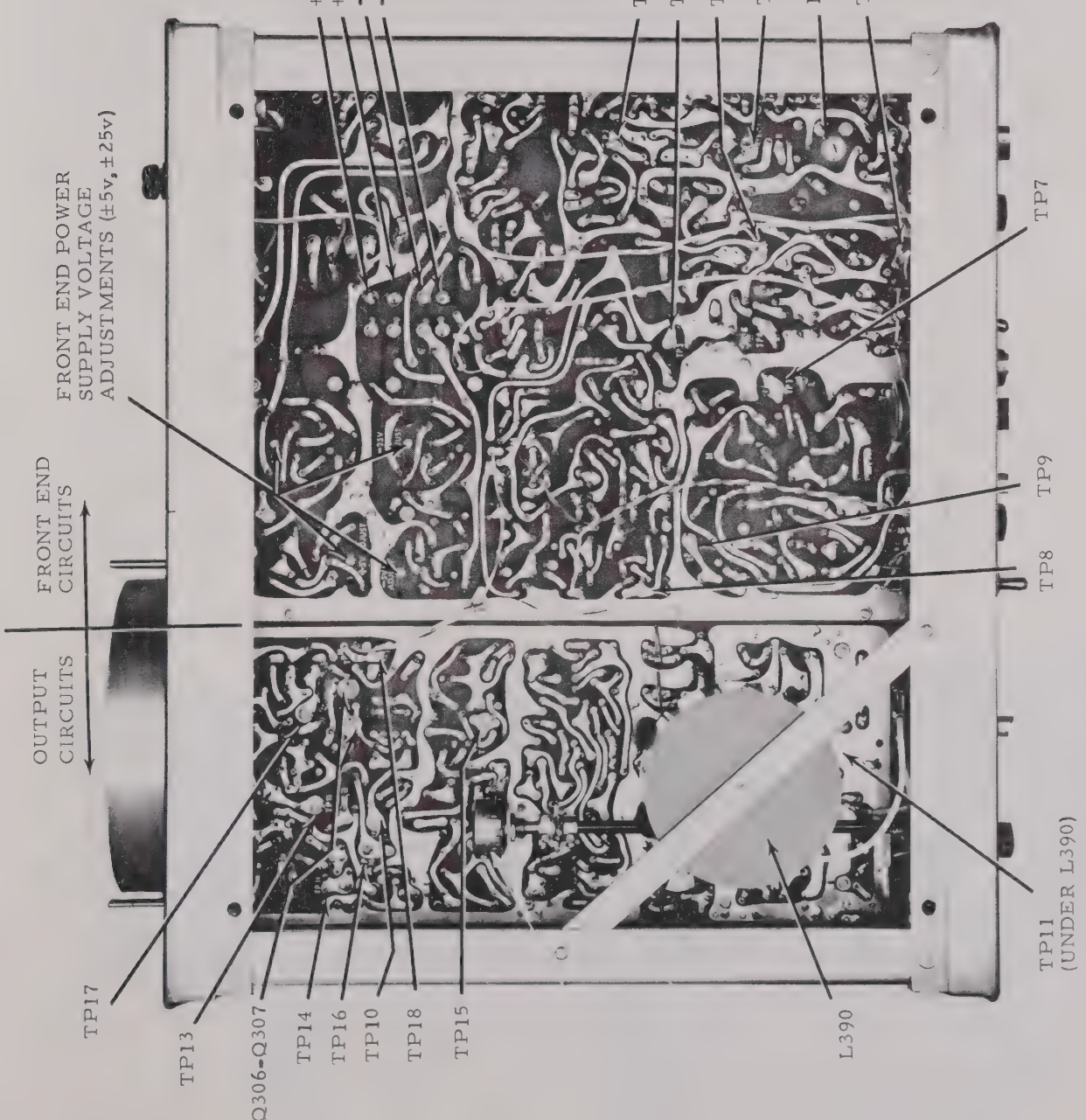


Figure 4-2. Adjustment and Test Point Locations.

4.3.1 Troubleshooting the Power Supplies

Almost all power supply failure may be typified by collector to emitter shorts (transistors) and anode to cathode shorts (rectifiers and zener diodes). These conditions are easily detected "in circuit" with an ohmmeter because they measure very low resistance in both directions.

4.3.2 Troubleshooting the Pulse Circuits

Once it has been ascertained that the power supplies are functioning correctly, the most straightforward method of tracking down a trouble is to begin at test point #1 and proceed through the instrument comparing waveforms to those listed in the schematic. This will generally narrow the trouble down to one of a very few components. Because of the straight through nature of the instrument circuitry, most troubles will manifest themselves as complete absence of output pulses or invariability of one or more of the pulse parameters. In the latter case, a good indication is given as to which circuit to suspect.

4.4 CALIBRATION PROCEDURE

4.4.1 General

Remove dust covers and connect instrument and ac voltmeter to auto transformer. Set to 115V ac (230V if so wired) and energize instrument. Allow five minutes warmup before commencing calibration. During this period make sure that the instrument is working properly. If any portion of the instrument fails to calibrate, repair should be effected before attempting to complete calibration.

4.4.2 Equipment Required

a) RMS reading ac voltmeter with 0-150V range (0-300V range if wired for 230V operation).

b) Variable line auto transformer such as Powerstat Series 20.

c) A multimeter with an accuracy of at least 3% and a sensitivity of 20,000 ohms per volt. Triplett 630 or equivalent.

d) A general purpose oscilloscope of at least 30 Mc band-pass with either delayed sweep or high sweep magnification. Hewlett-Packard 175A or Tektronix 543 is adequate.

e) A wide band oscilloscope such as HP Model 185B or Tektronix 661 is necessary for fine adjustment of output waveform.

f) 50 ohm 1%, 5W termination, Datapulse 2003.

g) An insulated, low-capacity screw driver.

h) Optional: 10 Mc counter HP Model 5243 or equivalent.

4.4.3 Power Supply Calibration

As the timing circuits are dependent upon the regulated power supply voltages for reference, any variances of these voltages will necessarily cause a change in calibration accuracy. Therefore, these adjustments should not be attempted unless one is prepared to carry out complete calibration.

Due to internal referencing within the power supply, the following sequence of adjustment must be followed: (output voltages are measured with respect to 0 ref. on the output power supply hinged circuit board -- all others are referenced to chassis ground).

a) Connect a dc voltmeter from +25V test point to ground. Set R516 (+25V ADJUST) for a reading of 25V. Vary line voltage ±10% around 115V and verify regulation.

b) Connect dc voltmeter from +5V test point to ground. Set R522 (+5V ADJUST) for a reading of 5 volts.

c) Connect dc voltmeter from -25V test point to ground. Set R536 (-25V ADJUST) for a reading of 25 volts. Vary line voltage ±10% around 115V and verify regulation.

d) Connect dc voltmeter from -5V test point to ground. Set R539 (-5V ADJUST) for a reading of 5 volts.

e) Check ripple on all supplies. Ripple should be less than 30 mV peak-to-peak.

f) Connect dc voltmeter from $-V_{cc}$ to 0 REF and verify a reading of approximately 65 volts.

g) Connect dc voltmeter from $-V_{c1}$ to 0 REF and verify a reading of approximately 45 volts.

h) Connect dc voltmeter from -50V to 0 REF. Set R423 (-50V ADJ) for a reading of 50 volts.

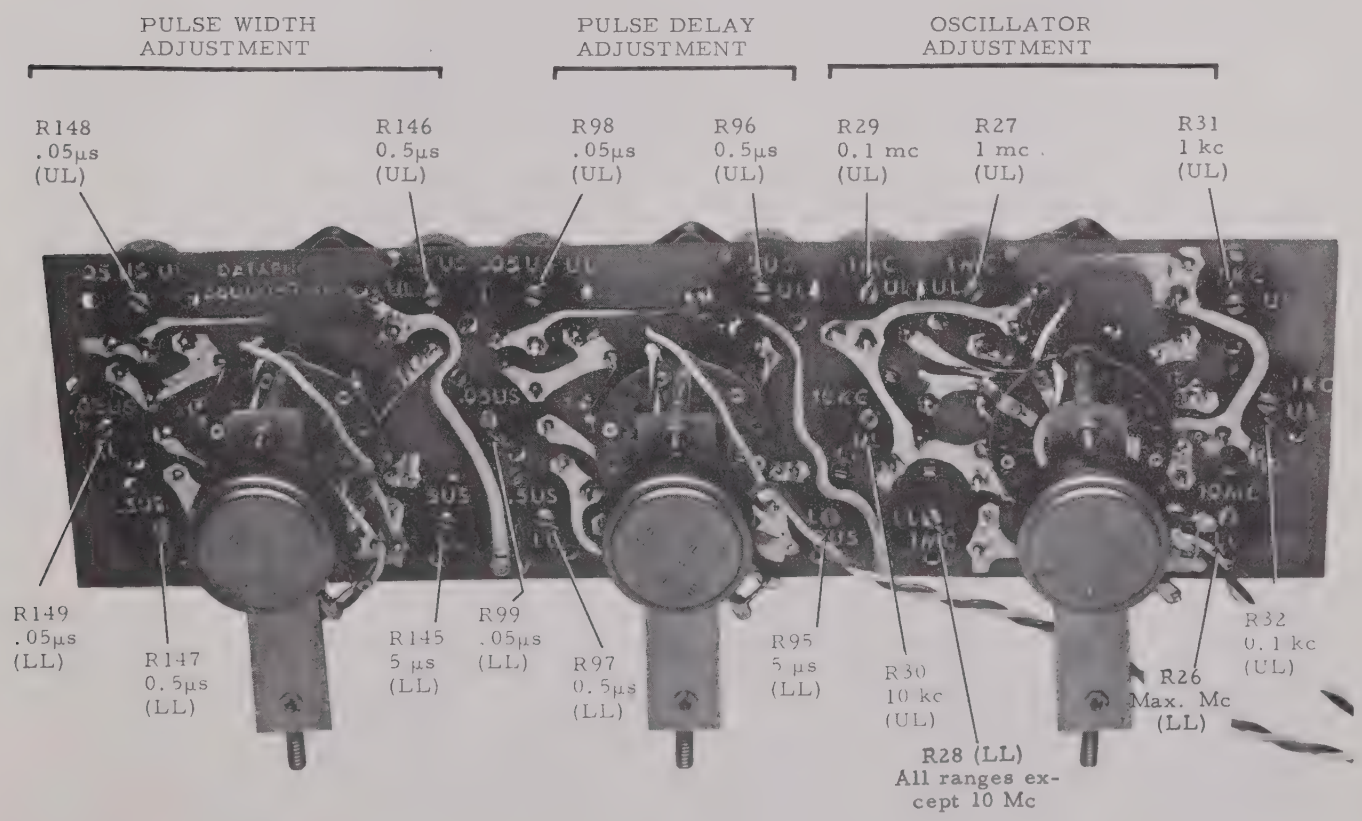
i) Connect dc voltmeter from -20V to 0 REF and verify a reading of between 19 and 21 volts.

j) Connect dc voltmeter from -15V to 0 REF. Set R426 (-15V ADJ) for a reading of 5 volts less than what the 20V supply reads. (See step (i) above.)

k) Connect dc voltmeter from -25V to 0 REF. Set R429 (-25V) for a reading of 5 volts more than what the 20V supply reads. (See step (i) above.)

TABLE 4-1
REPETITION RATE ADJUSTMENT

Rep. Rate Range	Vernier Position (R36)	Adj. To Be Made	Counter Reading	Pulse Spacing for Scope Calibration
10 Mc	cw	10 Mc UL (C4)	10 Mc	0.1 μs
10 Mc	ccw	10 Mc LL (R26)	1.0 Mc	1.0 μs
1 Mc	cw	1 Mc UL (R27)	1 Mc	1 μs
1 Mc	ccw	1 Mc LL (R28)	< 100 kc	10.0 μs
0.1 Mc	cw	0.1 Mc UL (R29)	100 kc	10 μs
0.1 Mc	ccw		< 10 kc	100 μs
10 kc	cw	10 kc UL (R30)	10 kc	0.1 ms
10 kc	ccw		< 1.0 kc	1.0 ms
1 kc	cw	1 kc UL (R31)	1 kc	1 ms
1 kc	ccw		< 100 c/s	10.0 ms
0.1 kc	cw	0.1 kc UL (R32)	100 c/s	10 ms
0.1 kc	ccw		10 c/s	0.1 sec.



4.4.4 Repetition Rate Calibration

NOTE: As calibration accuracy of most oscilloscopes is in the range of ±5%, the ultimate calibration accuracy of the instrument is limited by this value, i.e., if the instrument is calibrated using an oscilloscope which is 5% off in one direction and is then checked with another which is 5% off in the opposite direction, a 10% deviation will be shown. If calibration is performed using a frequency meter type of counter such as HP Model 5243, driving the counter with the positive sync pulse output, calibration accuracies of 1% or better can usually be obtained. However, one must bear in mind that if the output is then viewed on a 5% oscilloscope, this accuracy may appear as 6%. The following procedure is given for calibration of repetition rate using a counter.

a) Set DELAY and WIDTH controls to 0.05 μs with VERNIER fully ccw.

b) Adjust oscillator according to Table 4-1. The deviation on the lower limit (LL) adjustment is to provide a small measure of overlap of ranges and assure continuous coverage of all frequencies. The reason for adjusting upper limit (UL) first is that the upper limit adjustment affects both ends of the range while the upper limit is independent of lower limit setting. When using oscilloscope for calibration, view the positive pulse output terminated into 50 ohms with a 10 ns rise time. Widen pulse as necessary for oscilloscope presentation.

c) Recheck oscillator according to Table 4-2. It may be necessary to compromise setting of R28 (lower limit) so that the lower limit at the 1 mc through 0.1 kc ranges is within specification (i.e., less than the stated values).

TABLE 4-2
CHECK OF REPETITION RATE ADJUSTMENTS

Rep Rate Range	Vernier Position (R36)	Counter Reading ≥ =+5% -0%	Pulse Spacing for Scope Calibration
0.1kc	cw	≥ 100 c/s	10ms
0.1kc	ccw	< 10 c/s	0.1sec
1kc	cw	≥ 1kc	1ms
1kc	ccw	< 100 c/s	10.ms
10kc	cw	≥ 10kc	0.1ms
10kc	ccw	< 1kc	1ms
0.1 Mc	cw	≥ 100kc	10μs
0.1 Mc	ccw	< 10kc	100μs
1 Mc	cw	≥ 1 Mc	1μs
1 Mc	ccw	< 100kc	10μs
10 Mc	cw	≥ 10 Mc	0.1μs
10 Mc	ccw	< 1 Mc	1.0μs

4.4.5 Pulse Delay Calibration

Delay is measured from the 50% point on the leading edge of the positive sync output pulse to the 50% point on the main pulse output. Pulse delay accuracy is defined for minimum output pulse rise time.

NOTE: For calibration of pulse delay, a dual trace oscilloscope is convenient but not mandatory. To use a single channel oscilloscope, first view the positive sync output and align the 50% point of the leading edge with the left hand edge of the graticule by using the horizontial position control. Next, view the main pulse output and make delay measurement using the left hand edge of the graticule as a reference. For dual trace oscilloscope, view sync on one trace and the output pulse on the other.

a) Pulse spacing $\left(\frac{1}{\text{repetition rate}}\right)$ must be kept at least ten times the delay setting. Set PULSE WIDTH to 0.5 μs.

b) Adjust delay according to Table 4-3. The high upper limit calibration points are to insure overlap at ranges giving continuous coverage.

TABLE 4-3
DELAY CALIBRATION ADJUSTMENT

Delay Range	Vernier Position (R100)	Adjustment	Set Delay for	Scope Sweep Speed (per cm)	Rep. Rate
0.05μs	ccw	0.05μs LL(R99)	0ns	20ns	0.1 Mc
0.05μs	cw	0.05μs UL(R98)	0.52μs	0.1μs	0.1 Mc
0.5μs	ccw	0.5μs LL(R97)	0.5μs	0.1μs	10kc
0.5μs	cw	0.5μs UL(R96)	5.2μs	0.5μs	10kc
5μs	ccw	5μs LL(R95)	5μs	0.5μs	1kc

c) Recheck delay calibration according to Table 4-4. It may be necessary to compromise the adjustment of R95 (5μsLL) such that the lower limit of the 0.05 ms and 0.5 ms ranges is within specifications. It may be necessary to compromise the adjustment of R96 (0.5 μs UL) such that the upper limit of 5 μs, 0.05 ms and 0.5 ms ranges is within specifications.

TABLE 4-4
CHECK OF DELAY CALIBRATION ADJUSTMENTS

Delay Range	Vernier Position (R100)	Delay ≤ = +0% -5%, ≥ = +5% -0%	Scope Sweep Speed (per cm)	Rep. Rate
0.05μs	ccw	0ns	20ns	0.1Mc
0.05μs	cw	≥ 0.5μs	0.1μs	0.1 Mc
0.5μs	ccw	≤ 0.5μs	0.1μs	10kc
0.5μs	cw	≥ 5.μs	0.5μs	10kc
5μs	ccw	≤ 5μs	0.5μs	1kc
5μs	cw	≥ 50μs	5μs	1kc
0.05ms	ccw	≤ 50μs	5μs	0.1kc
0.05ms	cw	≥ 0.5ms	50μs	0.1kc
0.5ms	ccw	≤ 0.5ms	50μs	0.1kc
0.5ms	cw	≥ 5ms	0.5ms	10 c/s

4.4.6 Pulse Width Calibration

Pulse width is measured from the 50% point on the leading edge to the corresponding point on the lagging edge. Pulse width calibration accuracy is defined for minimum output pulse rise time.

a) Set PULSE DELAY to 0.05 μs, VERNIER Counterclockwise. Pulse spacing $\left(\frac{1}{\text{Repetition rate}}\right)$ must be kept at 10 times the pulse width during calibration.

b) Adjust PULSE WIDTH according to the following chart: the high upper limit calibration points assure that the ranges overlap to provide continuous coverage.

TABLE 4-5
WIDTH CALIBRATION ADJUSTMENTS

Width Range	Vernier Position (R150)	Adjustment	Set Width For	Scoop Sweep Speed	Rep. Rate
0.05μs	ccw	0.05μs LL(R149)	Min	20ns	0.1Mc
0.05μs	cw	0.05μs UL(R148)	0.52μs	0.1μs	0.1Mc
0.5μs	ccw	0.5μs LL(R147)	0.5μs	0.1μs	10kc
0.5μs	cw	0.5μs UL(R146)	5.2μs	0.5μs	10kc
5μs	ccw	LL(R145)	5μs	0.5μs	1kc

c) Recheck pulse width according to Table 4-6. It may be necessary to compromise the adjustment of R145 (5μsLL) such that the lower limit of the 0.05 ms and 0.5 ms ranges is within specification.

It may be necessary to compromise the adjustment of R146 (0.5μs UL) such that the upper limit of the 5μs, 0.05 ms and 0.5 ms ranges is within specification.

TABLE 4-6
CHECK OF WIDTH CALIBRATION ADJUSTMENTS

Width Range	Vernier Position (R150)	Width ≤ = +0% -5%, ≥ = +5% -0%	Scope Sweep Speed (per cm)	Rep. Rate
0.05μs	ccw	≤ 25ns	20ns	0.1Mc
0.05μs	cw	≥ 0.5μs	0.1μs	0.1Mc
0.5μs	ccw	≤ 0.5μs	0.1μs	10kc
0.5μs	cw	≥ 5μs	0.5μs	10kc
5μs	ccw	≤ 5μs	0.5μs	1kc
5μs	cw	≥ 50μs	5μs	1kc
0.05ms	ccw	≤ 50μs	5μs	0.1kc
0.05ms	cw	≥ 0.5ms	50μs	0.1kc
0.5ms	ccw	≤ 0.5ms	50μs	0.1kc
0.5ms	cw	≥ 5ms	0.5ms	10 c/s

4.4.7 Output Circuit Calibration

NOTE: For optimum performance, calibration of the output curcuits requires the use of a high bandpass oscilloscope such as the HP Model 185B.

CAUTION

When observing or making any connections to the output circuitry, including its power supply, it is necessary that the PULSE POLARITY switch be on OFF or NEG. The unit may be permanently damaged otherwise.

a) Set REPETITION RATE to 0.1 Mc/s.

b) Set PULSE DELAY to 0.1 μsec.

c) Set PULSE WIDTH to 0.5 μsec.

d) Sync oscilloscope from SYNC OUTPUT. Set sweep speed to .1 μsec/cm and view the NEG PULSE OUTPUT terminated into 50 ohms.

e) Adjust trimmer capacitor C201 (mounted on AMPLITUDE switch, behind front panel) for minimum overshoot and aberration (leading and trailing edges).

f) Set AMPLITUDE control to 50 VOLTS and its VERNIER to X1. Adjust the MAX AMPL control (R408 in output power supply on hinged circuit board) for 50 volts.

This completes calibration adjustment procedure for the DATAPULSE Model 108 Pulse Generator.

4.5 SPECIFICATION VERIFICATION

The following detailed test was performed on this instrument, just prior to shipment, to confirm published specifications. Before the test was conducted, the instrument was aged for a 24-hour period, and had undergone rigid examination for workmanship and appearance.

This test should be performed after every 200 hours of operation to confirm calibration status. Recalibrate and/or troubleshoot the instrument if the specifications are not verifiable.

4.5.1 Equipment Required

a) Oscilloscope, a general purpose oscilloscope of at least 30 Mc bandpass with either delayed sweep or high sweep magnification. Hewlett-Packard 175A or Tektronix 543 is adequate.

b) Oscilloscope, Hewlett-Packard 185B, Tektronix 661, or equivalent (high bandpass).

c) 50 ohm termination, Datapulse 2003.

d) 30 dB coaxial attenuator, greater than 300 Mc Bandpass.

e) Trigger generator (10 Mc).

f) Variable line autotransformer such as Powerstat Series 20.

4.5.2 Repetition Rate

Oscillator Timing:

a) Set PULSE DELAY to 0.05 μs, VERNIER ccw.

b) Set PULSE WIDTH to 0.05 μs, VERNIER ccw.

c) Set AMPLITUDE to 50V, VERNIER to X1.

d) Terminate outputs into 50Ω load.

e) Sync oscilloscope from SYNC OUTPUT.

f) View NEG PULSE OUTPUT with general purpose oscilloscope and follow the panel control settings in Table 4-7.

TABLE 4-7
REPETITION RATE CALIBRATION VERIFICATION

Rep. Rate Range	Vernier Position	Pulse Width	Sweep Speed (per cm)	Pulse Spacing	Tolerance
0.1kc	ccw	5 ms	100 ms	100ms (10cps)	
0.1kc	cw	.5ms	10 ms	10ms (0.1kc)	±5% *
1 kc	ccw	.5ms	10 ms	10ms (0.1kc)	
1 kc	cw	50μs	1 ms	1ms (1 kc)	±5%
10 kc	ccw	50μs	1 ms	1ms (1 kc)	
10 kc	cw	5 μs	100 μs	.1ms (10 kc)	±5%
0.1 Mc	ccw	5 μs	100 μs	.1ms (10 kc)	
0.1 Mc	cw	.5μs	10 μs	10μs (.1mc)	±5%
1 Mc	ccw	.5μs	10 μs	10μs (.1mc)	
1 Mc	cw	50ns	1 μs	1 μs (1mc)	±5%
10 Mc	ccw	50ns	1 μs	1 μs (1mc)	±5%
10 Mc	cw	50ns	.1 μs	.1 μs (10mc)	±5%

*See note at beginning of step 4.4.4.

Jitter:

a) Set controls as in a through f above.

b) Set REPETITION RATE to 10 Mc/s, VERNIER fully cw.

c) Set sweep speed to 0.1 μs/cm.

d) View POS PULSE OUTPUT terminated into 50Ω load. One pulse should appear for each cm. View the tenth pulse and expand sweep to 10 ns/cm. The jitter should be less than 0.1 cm (0.1%).

Stability: Leave setup as in above paragraph. Vary input voltage from 105V ac to 125V ac. The shift should be less than 0.2 cm (2%).

External Triggering: Apply a ±5V signal from trigger generator to the external TRIGGER INPUT jack and verify that instrument can be slaved up to 10 Mc with repetition rate control in both EXT + and EXT - positions.

Sync Pulse:

a) Set DELAY and WIDTH to minimum.

b) Set SYNC POLARITY to POS.

c) Set SYNC VOLTS cw.

d) View SYNC OUTPUT pulse into a 50 ohm load (2003 or equivalent).

e) Sync pulse amplitude should not drop below 6V when REPETITION RATE is varied from 1 Mc/s to 10 Mc/s.

f) Set SYNC POLARITY to NEG.

g) Verify sync pulse amplitude of 6V or more.

h) Set SYNC VOLTS ccw.

i) Verify sync pulse amplitude of approximately 0.25 volts.

External Gate Input:

a) View PULSE OUTPUT.

b) Verify that the output pulse does not occur upon application of minus six (-6) volts dc to the GATE INPUT connector.

4.5.3 Pulse Delay

Delay Timing:

a) Set pulse AMPLITUDE to 10 VOLTS and VERNIER to X1.

b) Set RISE TIME to minimum (ccw).

c) Set REPETITION RATE to 0.1 Mc/s, VERNIER cw.

d) Sync oscilloscope from SYNC OUTPUT.

e) View the SYNC OUTPUT and POS PULSE OUTPUT (50 ohm termination) simultaneously on dual trace oscilloscope.

f) Follow control settings in Table 4-8.

Delay Duty Cycle:

a) Set REPETITION RATE to 0.1 Mc/s, VERNIER cw.

b) Set PULSE WIDTH to 0.05 μs, VERNIER cw.

c) Sync oscilloscope from POS SYNC OUTPUT with sweep speed of 1 μs/cm.

d) View POS PULSE OUTPUT (50 ohm termination).

e) Set DELAY to 0.5 μs, VERNIER ccw. Slowly turn VERNIER cw and verify that 50% delay duty cycle (5 μs) can be attained without circuit failure.

TABLE 4-8.
DELAY CALIBRATION VERIFICATION

Delay Range	Vernier Position	Pulse Width	Rep. Rate	Sweep Speed (per cm)	Delay	Tolerance
0.05μs	ccw	50ns	0.1Mc	20ns	0	Approx.
0.05μs	cw	50ns	0.1Mc	50ns	0.5μs (10cm)	±0.5cm
0.5μs	ccw	0.5μs	10kc	50ns	0.5μs (10cm)	±0.5cm
0.5μs	cw	0.5μs	10kc	.5μs	5μs (10cm)	±0.5cm
5μs	ccw	5μs	1kc	.5μs	5μs (10cm)	±0.5cm
5μs	cw	5μs	1kc	5μs	50μs (10cm)	±0.5cm
0.05ms	ccw	0.05ms	0.1kc	5μs	50μs (10cm)	±0.5cm
0.05ms	cw	0.05ms	0.1kc	50μs	0.5ms (10cm)	±0.5cm
0.5ms	ccw	0.5ms	0.1kc	50μs	0.5ms (10cm)	±0.5cm
0.5ms	cw	0.5ms	10c/s	.5ms	5ms (10cm)	±0.5cm

Delay Jitter:

a) With controls set as in paragraph above (5 μs delay). Set sweep speed to 0.5 μs/cm and expand to 50 ns/cm.

b) View leading edge of pulse and verify that jitter is less than 0.1 cm (0.1%).

Delay Stability: With same setup as above paragraph, vary input voltage from 105V to 125V and verify that delay change is less than 0.2 cm (2%).

4.5.4 Pulse Width

Pulse Width Timing:

a) Set pulse AMPLITUDE to 10 VOLTS and VERNIER to X1.

b) Set RISE TIME ccw.

c) Set REPETITION RATE to 0.1 Mc/s, VERNIER cw.

d) Sync oscilloscope from SYNC OUTPUT.

e) View the POS PULSE OUTPUT (50 ohm termination).

f) Follow control settings in Table 4-9.

Pulse Width Duty Cycle:

a) Set REPETITION RATE to 0.1 Mc/s, VERNIER cw.

b) Set PULSE DELAY to 0.05 μs, VERNIER cw.

TABLE 4-9
WIDTH CALIBRATION VERIFICATION

Width Range	Vernier Position	Pulse Delay	Rep. Rate	Sweep Speed (per cm)	Tolerance	Width
0.05μs	ccw	50ns	0.1Mc	20ns		25ns (1cm)
0.05μs	cw	50ns	0.1Mc	50ns	±0.5cm	0.5μs (10cm)
0.5μs	ccw	0.5μs	10kc	50ns	±0.5cm	0.5μs (10cm)
0.5μs	cw	0.5μs	10kc	.5μs	±0.5cm	5μs (10cm)
5μs	ccw	5μs	1kc	.5μs	±0.5cm	5μs (10cm)
5μs	cw	5μs	1kc	5μs	±0.5cm	50μs (10cm)
0.05ms	ccw	0.05ms	0.1kc	5μs	±0.5cm	50μs (10cm)
0.05ms	cw	0.05ms	0.1kc	50μs	±0.5cm	0.5ms (10cm)
0.5ms	ccw	0.5ms	0.1kc	50μs	±0.5cm	0.5ms (10cm)
0.5ms	cw	0.5ms	10c/s	.5ms	±0.5cm	5ms

c) Sync oscilloscope from POS SYNC OUTPUT with sweep speed of 1 μs/cm.

d) View POS PULSE OUTPUT (50 ohm termination).

e) Set PULSE WIDTH to 0.5 μs, VERNIER ccw. Slowly turn VERNIER cw and verify that 50% WIDTH duty cycle (5 μs) can be attained without circuit failure.

Pulse Width Jitter:

a) With controls set as in paragraph above (5 μs pulse width). Set sweep speed to 0.5 μs/cm and expand to 50 ns/cm.

b) View lagging edge of pulse and verify that jitter is less than 0.1 cm (0.1%).

Pulse Width Stability: With the same setup as above paragraph, vary line voltage from 105V to 125V and verify that pulse width change is less than 0.2 cm (2%).

4.5.5 Main Pulse Output

Transition Time: (See Figure 4-4 for proper oscilloscope interconnections. Note: Check to make certain that the oscilloscope smoothing controls are not limiting its bandpass.)

a) Set REPETITION RATE to 0.1 Mc/s, VERNIER cw.

b) Set PULSE DELAY to 0.05 μsec, VERNIER approximately 10% rotated cw from full ccw position.

c) Set PULSE WIDTH to 0.05 μsec, VERNIER approximately 10% rotated cw from full ccw position (0.1 μsec pulse width).

d) Set pulse AMPLITUDE at 50 VOLTS, VERNIER to X1.

e) Set RISE TIME at MIN.

f) Set PULSE POLARITY on POS.

g) View the pulse leading edge on the sampling scope and verify that transition time is less than 7 nanoseconds from its 10% to 90% amplitude points.

h) View the pulse trailing edge on the sampling oscilloscope and verify that the transition time is less than 13 nanoseconds from its 10% to 90% amplitude points.

i) Set PULSE POLARITY on NEG.

j) Repeat steps (g) and (h) above.

Wave Shape: (See Figure 4-4 for proper oscilloscope interconnections.)

a) Set REPETITION RATE to 0.1 Mc/s, VERNIER ccw.

b) Set PULSE DELAY to 0.05 μsec, VERNIER approximately 10% rotated cw from full ccw position.

c) Set PULSE WIDTH to 0.05 μsec, VERNIER cw.

d) Set RISE TIME at MIN.

e) Set AMPLITUDE at 50V, VERNIER to X1.

f) Set overall oscilloscope sensitivity (attenuation of coaxial attenuators plus oscilloscope) to 2 volts per cm.

g) View the POS PULSE OUTPUT and verify that the waveform aberrations at the top and baseline of the pulse are less than 1 cm in amplitude (4%).

h) View the NEG PULSE OUTPUT and verify that the waveform aberrations at the top and baseline of the pulse are less than 1 cm in amplitude (4%).

i) Set AMPLITUDE at 5.0V, VERNIER to X1.

j) Set oscilloscope sensitivity to 200 millivolts per cm.

k) View the POS PULSE OUTPUT and verify that the waveform aberrations at the top and baseline of the pulse are less than 1 cm in amplitude (4%).

l) View the NEG PULSE OUTPUT and verify that the waveform aberrations at the top and baseline of the pulse are less than 1 cm in amplitude (4%).

m) Set AMPLITUDE at 0.20V, VERNIER to X1.

n) Set oscilloscope sensitivity to 10 mV/cm.

o) View the POS PULSE OUTPUT and verify that the waveform aberrations at the top and baseline of the pulse are less than 1.2 cm in amplitude (7%).

p) View the NEG PULSE OUTPUT and verify that the waveform aberrations at the top and baseline of the pulse are less than 1.2 cm in amplitude (7%).

q) Set the oscilloscope sensitivity to 200 mV/cm.

r) Rotate the RISE TIME control cw and verify that the pulse transition times increase to nearly 50 nanoseconds.

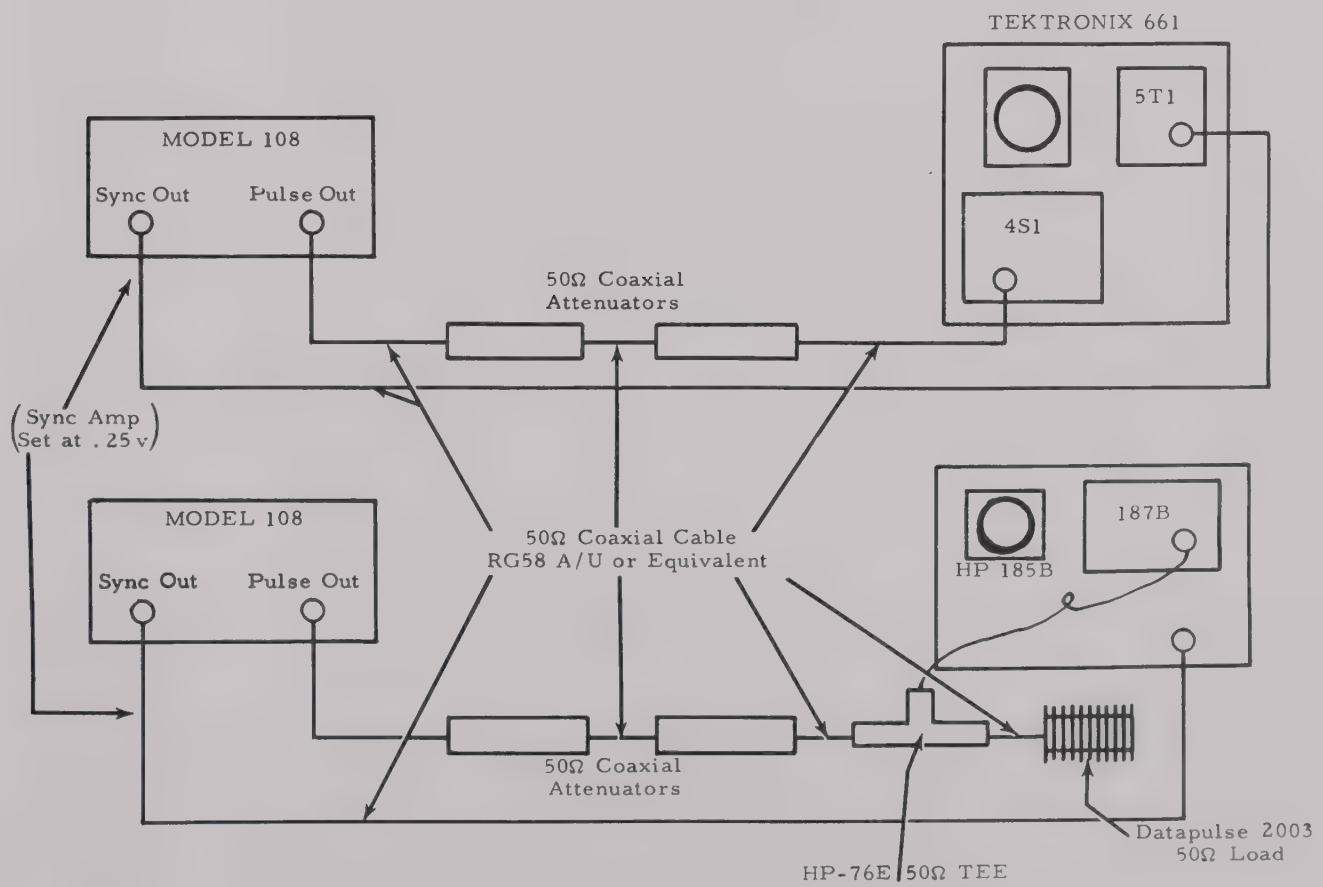


Figure 4-4.
Oscilloscope Interconnections for Waveform Verification.

SECTION V

PARTS LIST

5.1 HOW TO USE THIS PARTS LIST

5.1.1 Reference Designations

Reference designations used throughout this listing correspond with reference designations given on component location photos and the following schematics:

Drawing No. 40000-052B
Drawing No. 40000-053A
Drawing No. 40000-055B
Drawing No. 40000-056B
Drawing No. 40000-057B

Resistors are designated as R1, R2, R3, etc., and are fixed value, composition, 5% and 1/2w unless otherwise noted.

Capacitors are designated as C1, C2, C3, etc., and are fixed value, 5%, 500V dc unless otherwise noted.

Transistors are designated as Q1, Q2, Q3; diodes as CR1, CR2, CR3; switches as S1, S2, S3; inductors as L1, L2, and L3, etc.

5.1.2 Abbreviations

The following abbreviations are used:

CER	-	Ceramic
DPC	-	Deposited Carbon
ELECT	-	Electrolytic
M	-	Mica
MP	-	Metalized Paper
GMV	-	Guaranteed Min. Value
OF	-	Oil Filled
PT	-	Paper Tubular
S.M.	-	Silver Mica
VAR	-	Variable
WW	-	Wire Wound
VTQ	-	Vitamin Q
PNP	-	Positive-Negative-Positive
NPN	-	Negative-Positive-Negative
µsec	-	Microsecond
µF	-	Microfarad
µH	-	Microhenry
ns	-	Nanosecond
ms	-	Millisecond

5.1.3 Federal Manufacturers

Allen Bradley	A.B.
Chicago Telephone	C.T.
Ward Leonard	W.L.
Sangamo	Sangamo
MEC, Inc.	MEC
Cornell Dublier	C.D.
Electrocube	Electrocube
Sprague	Sprague
Erie	Erie
Motorola	Motorola
Centralab	Centralab
ACDC	ACDC
Corning	Corning
Magnetic Components	M.C.
Nashville Electronics	Nashville
Sylvania Electric	Sylvania
Radio Corp. of America	R.C.A.
General Electric	G.E.
Mallory	Mallory
Technitrol Engineering	Technitrol
Wilco	Wilco
Oak	Oak
Elmenco Products	Elmenco
Capco Corporation	Capco
Switchcraft Inc.	Switch
Westinghouse	Westinghouse
AH & H	AH & H
Buss	Buss
Barber Coleman	B.C.
Feroxcube	Ferox
Int'l. Business Assoc.	I.B.A.

5.2 RESISTORS

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
R1	4	560Ω,	10011-561	A.B.	EB5615
R2	1	430Ω	10011-431	A.B.	EB4315
R3	10	1.5k	10011-152	A.B.	EB1525
R4	6	390Ω	10011-391	A.B.	EB3915
R5	25	1k	10011-102	A.B.	EB1025
R6	2	750Ω	10011-751	A.B.	EB7515
R7	2	820Ω	10011-821	A.B.	EB8215
R8	1	10Ω	10011-100	A.B.	EB1005
R9	8	47Ω	10011-470	A.B.	EB4705
R10		Same as R3			
R11	6	2.7k	10011-272	A.B.	EB2725
R12		Same as R7			
R13	17	470Ω	10011-471	A.B.	EB4715
R14	2	3.9k	10011-392	A.B.	EB3925
R15		Same as R5			
R16		Same as R13			
R17	2	51Ω	10011-510	A.B.	EB5105
R18		Same as R11			
R19	26	10k	10011-103	A.B.	EB1035
R20	8	100k	10011-104	A.B.	EB1045
R21		Same as R13			
R22 through R24		Not Used			
R25		Same as R6			
R26	5	250k, var., 0.2W, 30%	20240-254		
R27	5	2.5k, var., 0.2W, 30%	20240-252		
R28	1	100k, var., 0.2W, 30%	20240-104		
R29 through R32		Same as R27			
R33	4	15k	10011-153	A.B.	EB1535
R34		5k, 2W, 10% var.	20053-502	A.B.	
R35	7	4.7k	10011-472	A.B.	EB4725
R36	1	100k, 2W, 10% var.	20053-104	A.B.	
R37	10	100Ω	10011-101	A.B.	
R38		Not Used			
R39		Not Used			
R40		Not Used			
R41	3	22k	10011-223	A.B.	EB2235
R42		Same as R9			
R43		Same as R9			
R44		Same as R13			
R45		Same as R1			
R46	4	200Ω	10011-201	A.B.	EB2015
R47		Same as R13			
R48		Same as R5			
R49	19	22Ω	10011-220	A.B.	EB2205
R50		Same as R46			
R51		Same as R11			
R52		Same as R20			
R53		Same as R4			
R54	3	220Ω	10011-221	A.B.	EB2215
R55		Same as R5			
R56		Same as R19			
R57		Same as R37			
R58		Same as R5			
R59		Same as R5			
R60	6	47k	10011-473	A.B.	EB4735
R61		Same as R49			
R62	1	.50Ω, var.,comp., dual gauged	20213-500S	A.B.	Type JJ

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
R63	1	51Ω, 2W, Met. film	10723-510	Corning	Type C42
R64		Same as R17			
R65		Same as R5			
R66		Same as R46			
R67		Same as R9			
R68	2	470Ω, 2W	10013-471	A.B.	HB4715
R69		Not Used			
R70	7	27k	10011-273	A.B.	EB2735
R71		Same as R33			
R72	2	3k	10011-302	A.B.	EB3025
R73		Same as R49			
R74		Same as R37			
R75		Same as R3			
R76		Same as R37			
R77		Same as R3			
R78		Same as R49			
R79		Same as R70			
R80	2	1.2k, 1W	10012-122	A.B.	GB1225
R81	5	680Ω	10011-681	A.B.	EB6815
R82	4	330Ω	10011-331	A.B.	EB3315
R83		Same as R37			
R84	1	1.8k	10011-182	A.B.	EB1825
R85		Same as R13			
R86		Same as R13			
R87		Same as R9			
R88		Same as R54			
R89		Same as R9			
R90		Same as R11			
R91		Same as R4			
R92		Same as R5			
R93		Same as R81			
R94		Same as R60			
R95	6	10k, var., 0.2W, 30%	20240-103	C.T.	
R96		Same as R6			
R97		Same as R95			
R98		Same as R26			
R99		Same as R95			
R100	2	150k, var., 2W, 10%	20053-154	A.B.	
R101	3	180Ω			
R102		Same as R13			
R103		Same as R9			
R104		Same as R11			
R105		Same as R4			
R106		Same as R101			
R107		Same as R3			
R108	1	1.2k	10011-122	A.B.	EB1225
R109		Same as R82			
R110		Same as R19			
R111		Same as R5			
R112		Same as R19			
R113		Same as R20			
R114		Same as R19			
R115		Same as R35			
R116		Same as R20			
R117		Same as R5			
R118		Same as R5			
R119		Same as R70			
R120		Same as R33			
R121		Same as R5			
R122		Same as R19			
R123		Same as R19			
R124		Same as R20			
R125		Same as R5			
R126		Same as R35			

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
R127		Same as R20			
R128		Same as R19			
R129		Same as R41			
R130		Same as R13			
R131		Same as R5			
R132		Same as R13			
R133		Same as R60			
R134 through R139		Not Used			
R140		Same as R70			
R141		Same as R33			
R142		Same as R72			
R143		Same as R54			
R144		Same as R37			
R145		Same as R95			
R146		Same as R26			
R147		Same as R95			
R148		Same as R26			
R149		Same as R95			
R150		Same as R100			
R151		Same as R60			
R152		Same as R81			
R153		Same as R3			
R154		Same as R37			
R155		Same as R13			
R156		Same as R9			
R157	1	150Ω	10011-151	A.B.	EB1515
R158		Same as R3			
R159		Same as R11			
R160		Same as R4			
R161		Same as R49			
R162		Same as R70			
R163		Same as R80			
R164		Same as R101			
R165 through R200		Not Used			
R201	8	12Ω, 2W, fxd. met. film	10723-120	Corning	Type C42
R202	8	11Ω, 2W, fxd. met. film	10723-110	Corning	Type C42
R203	4	220Ω, 5W, fxd. met. film	10764-221	Corning	LP1-5
R204		Same as R201			
R205		Same as R202			
R206		Same as R201			
R207		Same as R202			
R208		Same as R203			
R209		Same as R201			
R210		Same as R202			
R211		Same as R201			
R212		Same as R202			
R213		Same as R203			
R214		Same as R201			

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
R215		Same as R202			
R216		Same as R201			
R217		Same as R202			
R218		Same as R203			
R219		Same as R201			
R220		Same as R202			
R221		Same as R37			
R222 through R230		Not Used			
R231	5	130Ω, 3W	10754-131	Corning	LP1-3
R232 through R235		Same as R231			
R236	4	36Ω, 3W	10754-360	Corning	LP1-3
R237		Same as R236			
R238	3	75Ω, 3W	10754-750	Corning	LP1-3
R239		Same as R238			
R240		Same as R238			
R241		Same as R236			
R242		Same as R236			
R243	6	27Ω, 2W	10013-270	A.B.	HB2705
R244	3	36Ω, 2W	10013-360	A.B.	HB3605
R245		Same as R243			
R246		Same as R243			
R247		Same as R244			
R248		Same as R243			
R249		Same as R243			
R250		Same as R244			
R251		Same as R243			
R252 through R300		Not Used			
R301	2	120Ω	10011-121	A.B.	EB1215
R302		Same as R70			
R303		Same as R20			
R304	3	1.5k, 1W	10012-152	A.B.	GB1525
R305		Same as R3			
R306		Same as R3			
R307		Same as R20			
R308		Same as R70			
R309		Same as R301			
R310		Same as R304			
R311		Same as R37			
R312	1	680Ω, 2W	10013-681	A.B.	HB6815
R313		Same as R13			
R314		Same as R19			

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
R315		Same as R68			
R316		Not Used			
R317		Not Used			
R318		Not Used			
R319		Not Used			
R320		Same as R46			
R321	1	5.1k	10011-512	A.B.	EB5125
R322		Same as R19			
R323		Same as R5			
R324	1	15Ω	10011-150	A.B.	EB1505
R325		Same as R13			
R326 through R329		Not Used			
R330		Same as R37			
R331	1	510Ω	10011-511	A.B.	EB5115
R332	6	2.2k	10011-222	A.B.	EB2225
R333		Same as R60			
R334		Same as R5			
R335		Same as R5			
R336	3	100Ω, 1/4W	10010-101	A.B.	GB1015
R337		Same as R332			
R338		Same as R35			
R339		Same as R41			
R340		Same as R5			
R341		Same as R332			
R342		Same as R19			
R343		Same as R304			
R344		Same as R336			
R345 through R349		Not Used			
R350 through R353		Same as R49			
R354 through R359		Same as R19			
R360		Same as R49			
R361		Same as R49			
R362		Same as R5			
R363		Same as R49			
R364		Same as R49			
R365 through R368		Same as R19			
R369		Same as R336			
R370 through R375		Same as R49			
R376	6	2.7k, 2W	10013-272	A.B.	HB2725

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
R377 through R381		Same as R376			
R382	6	27Ω	10011-270	A.B.	EB2705
R383 through R387		Same as R382			
R388		Same as R13			
R389	1	1k, 2W	10013-102	A.B.	HB1025
R390		Same as R5			
R391	1	100k, 1/4W	10010-104	A.B.	CB10445
R392	1	2Ω, 5W, var.	10404-209		
R393 through R399		Not Used			
R400		Same as R19			
R401		Same as R60			
R402	2	2.7Ω, 1W, 10%	10022-279	A.B.	GB2791
R403		Same as R402			
R404	1	1k, 1/4W	10010-102		
R405		Same as R19			
R406		Same as R14			
R407	1	1k, 2W, var. comp., 10%	20053-102	A.B.	JA1N 056 102UA
R408	5	1k, 0.2W, 30%, P.C. mtg.	20240-102	A.B.	UPE 70
R409*	1	4.3k	10011-432	A.B.	EB4325
R410 through R419		Not Used			
R420		Same as R11			
R421	1	10Ω, 1W, 10%	10022-100	A.B.	GB1001
R422		Same as R19			
R423	1	10k, 0.2W, 30%, P.C. mtg.	20240-103	C.T.	UPE 70
R424		Same as R19			
R425		Same as R108			
R426	2	500Ω, 2W, 20%, var. WW	10493-501	A.B.	
R427	2	270Ω,	10011-271	A.B.	EB2715
R428		Same as R427			
R429		Same as R426			

* May be factory adjusted.

PARTS LIST

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
R430		Same as R332			
R431		Same as R35			
R432	1	470Ω, 1W, 10%	10022-471	A.B.	GB4711
R433		Not Used			
R434	1	62Ω, 2W	10013-620	A.B.	HB6215
R435 through R439		Not Used			
R440		Same as R4			
R441		Not Used			
R442		Not Used			
R443		Same as R5			
R444		Same as R13			
R445 through R500		Not Used			
R501	1	33k	10011-333	A.B.	EB3335
R502 through R509		Not Used			
R510	2	5Ω, 5W	10304-509	W.L.	SF5
R511	2	200Ω, 5W	10304-201	W.L.	SF200
R512		Same as R81			
R513		Same as R19			
R514		Same as R35			
R515		Same as R5			
R516		Same as R408			
R517		Same as R13			
R518		Not Used			
R519		Not Used			
R520		Not Used			
R521		Same as R332			
R522		Same as R408			
R523		Same as R82			
R524		Same as R5			
R525		Same as R1			
R526		Same as R3			
R527	1	75 Ω, 10W	10305-750	W.L.	10F75
R528		Not Used			
R529		Not Used			
R530		Same as R511			
R531		Same as R510			
R532		Same as R81			
R533		Same as R19			
R534		Same as R35			
R535		Same as R13			
R536		Same as R408			
R537		Same as R5			
R538		Same as R332			
R539		Same as R408			
R540		Same as R82			
R541		Same as R5			
R542		Same as R1			
R543		Same as R3			
R544	1	47Ω, 2W	10013-470	A.B.	HB4705
R545	1	100Ω, 10W	10305-101	W.L.	10F10O
R546	1	18Ω, 1W	10012-180	A.B.	GB1805

5.3 CAPACITORS

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
C1	79	0.1 µF, 75V, ceramic disc	11242-104	Centralab	DDA-104
C2		Same as C1			
C3		Same as C1			
C4	2	4-30 pF, var. ceramic	11307-300	Erie	503-000
C5	1	1000 pF, 1%	11027-102	Sangamo	
C6	2	0.01 µF, 300V, 1%	11025-103	Sangamo	
C7	1	0.1 µF, 100V, 1%	11093-104	Electrocube	
C8	1	1 µF, 150V, 1%	11093-105	Electrocube	
C9	1	10 µF, 20V, 10%	11511-106	Sangamo	
C10	6	27 pF, S.M.	11017-270	Sangamo	RR1427
C11		Same as C1			
C12	1	39 pF, S.M.	11017-390	Sangamo	
C13		Same as C6			
C14		Same as C10			
C15		Same as C1			
C16	9	100 µF, 35V, Elect. P.C. mtg.	11162-107	Nashville	20-500-DP100-35585
C17	1	1 µF, 50V, Elect.	11152-105	MEC, Inc.	EG8-1-50P
C18		Same as C1			
C19	2	470 pF, 300V, S.M.	11015-471	Sangamo	RR06347
C20		Same as C1			
C21	2	20 µF, 50V	11252-206	Sprague	TE1305
C22 through C38		Not Used			
C39		Same as C16			
C40		Same as C1			
C41		Same as C19			
C42		Same as C1			
C43		Same as C1			
C44	9	47pF, S.M.	11017-470	Sangamo	RR1447
C45	9	100pF, S.M.	11017-101	Sangamo	RR1310
C46		Same as C1			
C47		Same as C1			
C48		Same as C45			
C49		Same as C44			
C50		Same as C1			
C51		Same as C1			
C52 through C69		Not used			
C70		Same as C45			
C71		Same as C1			
C72		Same as C16			
C73		Same as C1			
C74		Same as C1			
C75		Same as C1			
C76		Same as C44			
C77	2	470pF, 300V, 1%	11005-471	Sangamo	
C78	2	4700pF, 1%	11025-472	Elmenco	
C79	2	0.047pF, 100V, 1%	11123-473		
C80	2	0.47µF, 200V, 1%	11124-474	Capco	
C81		Same as C1			
C82		Same as C1			
C83		Same as C16			
C84		Same as C1			
C85		Same as C44			
C86		Same as C1			
C87		Same as C1			
C88		Same as C1			
C89		Same as C45			

PARTS LIST

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
C90		Same as C1			
C91		Same as C45			
C92 through C99		Not Used			
C100		Same as C1			
C101		Same as C1			
C102	3	100 µF, 12V, Elect.	11151-107	C.D.	NLW100-12
C103		Same as C45			
C104		Same as C44			
C105		Same as C102			
C106		Same as C45			
C107		Same as C44			
C108		Same as C1			
C109		Same as C1			
C110		Same as C1			
C111 through C129		Not Used			
C130		Same as C44			
C131		Same as C77			
C132		Same as C78			
C133		Same as C79			
C134		Same as C80			
C135 through C138		Not Used			
C139		Same as C1			
C140		Same as C45			
C141 through C144		Same as C1			
C145		Same as C45			
C146		Same as C1			
C147		Same as C16			
C148		Same as C1			
C149	1	4000 µF, 10V, Tabs	11170-408	C.D.	1040FB
C150 through C200		Not Used			
C201		Same as C4			
C202 through C300		Not Used			
C301		Same as C1			
C302		Same as C10			
C303		Same as C1			
C304		Same as C1			
C305		Same as C10			
C306		Same as C1			
C307		Same as C1			
C308	1	150 µF, S.M.	11017-151	Sangamo	RR1315
C309		Same as C1			
C310	4	100 µF, 35V, Elect.	11159-107	Nashville	22-500 BP100-35D85
C311		Same as C1			

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
C312 through C319		Not Used			
C320		Same as C44			
C321	1	33 pF, S.M.	11017-330	Sangamo	RR1433
C322 through C329		Not Used			
C330		Same as C1			
C331		Same as C1			
C332		Same as C10			
C333		Same as C1			
C334		Same as C1			
C335		Same as C1			
C336	7	220 pF, S.M.	11017-221	Sangamo	RR1322
C337		Same as C10			
C338	3	10 µF, 100V, Elect.	11153-106	Sprague	
C339		Same as C21			
C340		Same as C1			
C341		Same as C1			
C342		Same as C44			
C343 through C349		Not Used			
C350 through C353		Same as C1			
C354		Not Used			
C355		Same as C310			
C356		Same as C310			
C357		Not Used			
C358 through C362		Same as C1			
C363		Same as C338			
C364		Same as C1			
C365 through C369		Not Used			
C370		Same as C1			
C371		Same as C338			
C372 through C376		Same as C1			
C377 through C382		Same as C336			
C383 through C390		Same as C1			
C391		Same as C102			
C392		Same as C1			
C392 through C399		Not Used			
C400	2	300 µF, 150V, Elect.	11153-307	Sprague	TVA1425
C401		Same as C400			

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
C402 through C419		Not Used			
C420	3	10 µF, 100V, Elect.	11153-106	Sprague	TE1407
C421		Same as C420			
C422 through C439		Not Used			
C440	2	500 µF, 50V, Elect.	11152-507	Sprague	TVA1315
C441		Same as C440			
C442		Not Used			
C443		Same as C310			
C444		Same as C420			
C445 through C500		Not Used			
C501 through C509		Not Used			
C510	2	1500 µF, 50V, Elect.	11162-158	Sangamo	PLP1500-50VE
C511		Same as C16			
C512		Same as C16			
C513		Same as C1			
C514		Not Used			
C515		Same as C1			
C516 through C529		Not Used			
C530		Same as C510			
C531		Same as C16			
C532		Same as C16			
C533		Not Used			
C534		Not Used			
C535		Same as C1			

5.4 TRANSISTORS

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
Q1	6	Silicon, PNP	22595-000		DP59-0
Q2	34	Silicon, NPN	22635-004		DP53-4
Q3		Same as Q2			
Q4		Same as Q2			
Q5		Same as Q2			
Q6	9	Silicon, NPN	22635-003		DP63-3
Q7	3	Silicon, PNP	22605-006		DP60-6
Q8		Same as Q2			
Q9		Same as Q2			
Q10		Same as Q2			
Q11		Same as Q7			
Q12		Same as Q7			
Q13	8	Silicon, NPN	12685-004	Motorola	SM1330 or DP63-6
Q14		Same as Q13			
Q15 through Q17		Same as Q2			
Q18		Same as Q6			
Q19 through Q32		Same as Q2			
Q33		Same as Q13			
Q34		Same as Q2			
Q35		Same as Q6			
Q36 through Q41		Same as Q2			
Q42		Same as Q6			
Q43 through Q300		Not Used			
Q301	7	Germ., PNP	22465-001		DP46-1
Q302		Same as Q301			
Q303		Same as Q6			
Q304	5	Silicon, PNP	22605-001	Motorola	DP60-1
Q305		Not Used			
Q306		Same as Q2			
Q307		Same as Q2			
Q308 through Q311		Same as Q301			
Q312		Same as Q13			
Q313		Same as Q301			
Q314		Same as Q6			
Q315		Same as Q304			
Q316		Same as Q6			
Q317		Same as Q304			
Q318		Same as Q6			
Q319		Same as Q304			
Q320		Same as Q1			
Q321		Same as Q6			
Q322		Same as Q304			
Q323	6	Silicon, PNP	22605-002	Motorola	DP60-2
Q324 through Q328		Same as Q323			
Q329	6	Silicon, NPN	12635-001		2N3723
Q330 through Q334		Same as Q329			
Q335 through Q399		Not Used			

PARTS LIST

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
Q400	1	NPN Silicon	12676-003	Westinghouse	W15209
Q401	4	NPN Silicon	12695-001	R.C.A.	2N2270
Q402		Same as Q401			
Q403		Same as Q401			
Q404 through Q419		Not Used			
Q420	5	PNP Germanium	12455-008	Motorola	2N1535
Q421		Same as Q1			
Q422		Same as Q401			
Q423		Same as Q13			
Q424 through Q439		Not Used			
Q440		Same as Q420			
Q442 through Q500		Not Used			
Q501		Same as Q1			
Q502		Same as Q13			
Q503		Same as Q420			
Q504		Not Used			
Q505		Same as Q2			
Q506		Same as Q420			
Q507		Not Used			
Q508		Same as Q420			
Q509		Same as Q13			
Q510		Same as Q1			
Q511		Same as Q1			
Q512		Same as Q13			

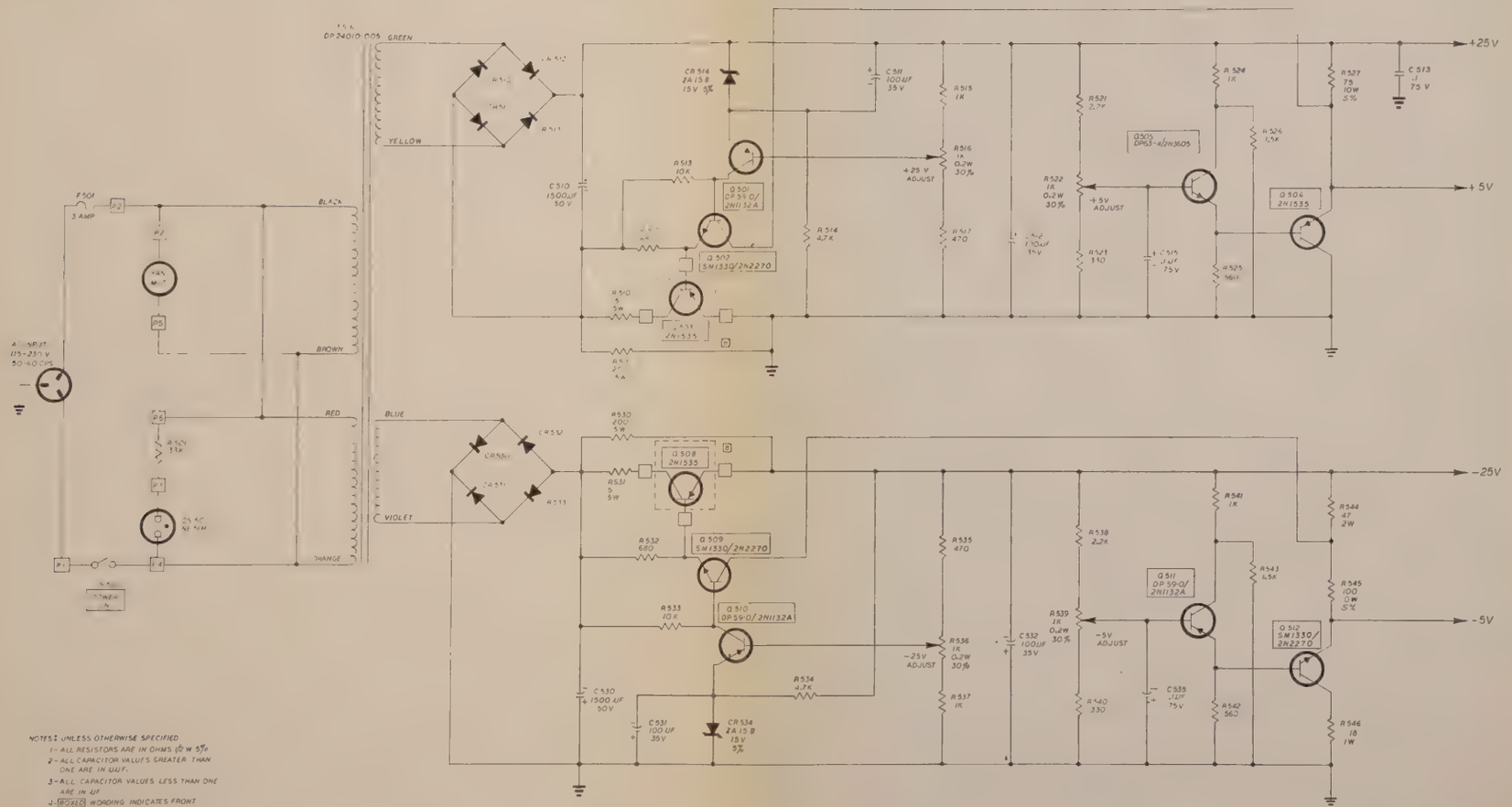
5.5 DIODES

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
CR1	3	Germanium, 15V	12144-003	Sylvania	1N995
CR2	54	Silicon, 40V	22164-000		DP16-0
CR3		Same as CR2			
CR4		Same as CR2			
CR5		Same as CR2			
CR6		Same as CR2			
CR7 through CR40		Not Used			
CR41 through CR47		Same as CR2			
CR48	5	Rectifier, Silicon 400V	22194-000		DP19-0
CR49 through CR69		Not Used			
CR70		Same as CR2			
CR71		Same as CR2			
CR72	19	Rectifier, Silicon, 100V	22194-001		DP19-1
CR73		Same as CR2			
CR74		Same as CR1			
CR75		Same as CR2			
CR76		Same as CR2			
CR77		Same as CR2			
CR78		Not Used			
CR79		Not Used			
CR80		Same as CR2			
CR81		Same as CR2			
CR82 through CR98		Not Used			
CR99 through CR104		Same as CR 2			
CR105 through CR139		Not Used			
CR140		Same as CR2			
CR141		Same as CR2			
CR142		Same as CR72			
CR143		Same as CR2			
CR144		Same as CR1			
CR145		Same as CR2			
CR146		Same as CR2			
CR147		Same as CR2			
CR148 through CR300		Not Used			
CR301		Same as CR2			
CR302		Same as CR2			
CR303		Same as CR2			

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
CR304		Same as CR2			
CR305		Same as CR2			
CR306		Same as CR2			
CR307		Same as CR2			
CR308 through CR319		Not Used			
CR320 through CR325		Same as CR2			
CR326 through CR329		Not Used			
CR330	3	Zener, 10V, 1W, 5%	12154-022	Mallory	ZA10B
CR331		Same as CR2			
CR332		Same as CR2			
CR333 through CR349		Not Used			
CR350 through CR356		Same as CR2			
CR357 through CR369		Not Used			
CR370 through CR374	8	Silicon, Diode, 80V	22164-001		DP16-1
CR375 through CR379		Same as CR72			
CR380		Same as CR370			
CR381		Same as CR370			
CR382		Same as CR370			
CR383 through CR399		Not Used			
CR400 through CR403		Same as CR72			
CR404	5	Zener, 15V, 1W, 5%	12154-017	Mallory	ZA10B
CR405		Same as CR404			
CR406 through CR419		Not Used			
CR420		Same as CR330			
CR421		Same as CR330			
CR422 through CR439		Not Used			
CR440 through CR443		Same as CR48			
CR444		Same as CR404			
CR445 through CR509		Not Used			
CR510 through CR513		Same as CR72			
CR514		Same as CR404			
CR515 through CR529		Not Used			
CR530 through CR533		Same as CR72			
CR534		Same as CR404			

5.6 MISCELLANEOUS

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	MANUFACTURER	MFRS. PART NO.
T41	9	Pulse Xfmr, 1:1, 5%, 6 μH	14165-001	Technitrol	1W6HA
T42		Same as T41			
T43		Same as T41			
T81		Same as T41			
T82		Same as T41			
T140		Same as T41			
T301		Same as T41			
T302		Same as T41			
T320		Same as T41			
T400	1	Isolation Xfmr	24080-000	ACDC	24080-000
T501	1	Pwr. Xfmr., w/extra end bell	24010-005	McCarron	24010-005
DL41	1	Delay line .13μs, 500Ω	14200-005	M.C.	
DL81	1	Delay line .026μs, 320Ω	14190-000	Technitrol	
DL330	1	Delay line, 0.1 μs, 500Ω	14200-000	M.C.	DDL500-0.1
L1	1	Inductor, 10 μH	14284-003	Wilco	
L2	1	Inductor, 15μH	14284-000	Wilco	1015-15-150
L320	1	Inductor, 1 μH	14284-002	Wilco	
L390	1	Output Xfmr.	32000-009		
F501	1	Fuse, 3 amp.	15470-003	Buss	AGC-3
DS101	1	Lamp, Incandescent	15450-006	G.E.	1819
DS501	1	Lamp, Neon	15450-001	G.E.	NE51H
S1	1	Rotary Switch	25250-018B	Oak	
S2	1	Pushbutton Switch	15300-001	Switch	
S3	1	Rotary Switch	25250-019B	Oak	
S4	1	Rotary Switch	25250-019B	Oak	
S5	1	Switch, DPST	15280-009	AH & H	
S6	1	Rotary Switch	25260-001A	Oak	
S390	1	Switch, DPDT	15280-004	AH & H	
S501	1	Switch, SPST	15280-000	AH & H	
	1	Fan Motor	13350-000	B.C.	
	1	Fan Blade	15490-000	Torr	
	1	Power Cord	17130-005	I.B.A.	
		Ferrite Bead	19170-000	Ferox	
		Half Ferrite Bead	19170-001	Ferox	



NOTES: UNLESS OTHERWISE SPECIFIED

1 - ALL RESISTORS ARE IN OHMS ½ W 5%
2 - ALL CAPACITOR VALUES GREATER THAN ONE ARE IN UUF
3 - ALL CAPACITOR VALUES LESS THAN ONE ARE IN UF
4 - (BOXED) WORDING INDICATES FRONT PANEL NOMENCLATURE
5 - (BOXED) LETTERS AND/OR NUMBERS INDICATE SPECIFIC LABELED POINTS ON CIRCUIT BOARD
6 - ALL DIODES ARE DP 19-1/1N4002
7 - T501 IS SHOWN CONNECTED FOR 115VAC OPERATION
FOR 230 VAC OPERATION:
1. BREAK CONNECTION BETWEEN BLACK AND RED WIRES
2. BREAK CONNECTION BETWEEN BROWN AND ORANGE WIRES
3. CONNECT BROWN AND RED WIRES

(A) - Q503 Q508 ARE MOUNTED ON BACK PANEL

REV'S	DESCRIPTION
A	1) ADDED C513 2) R527 75Ω WAS 100Ω 3) 2N1535 WAS 2N669 Q503 506 508 4) 1500 UF WAS 1250UF C510, 530 5) ZA15B WAS IN966A CR514, 534 6) SM1330/2N2270 WAS 2N697 Q502, 509, 512 7) DP63-0/2N2369 WAS 2N706 Q505

DS 501	DS 501	
F 501	F 501	
T 501	T 501	
S 501	S 501	
Q 501	Q 512	Q 504, 507,
CR 510	CR 534	CR 515-529
C 510	C 535	C 500-509, 514, 516-529, C 533, 534
R 501	R 546	R 502-509, 518-520, 528-529
FIRST USED	LAST USED	OMITTED

REFERENCE DESIGNATIONS (501-599)

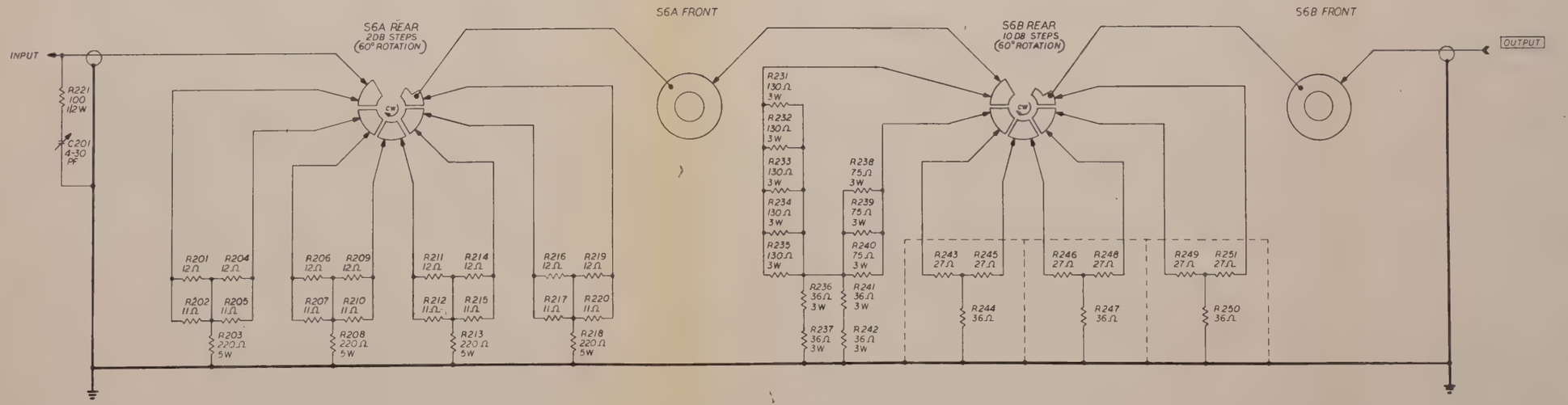
SCHEMATIC - POWER SUPPLY +5V, ±25V

108 C
SB
USED ON

40000-052

REVISIONS				
471	A	ALL 200 SERIES REF DES WAS 100 SERIES	4/9 63	

AMPLITUDE
VOLTS
WITH 50Ω TERMINATION



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE 2W, 5%
2. SWITCHES ARE SHOWN IN FULLY COUNTER CLOCKWISE POSITION AS VIEWED FROM CONTROL KNOB
3. BOXED WORDING INDICATES FRONT PANEL NOMENCLATURE

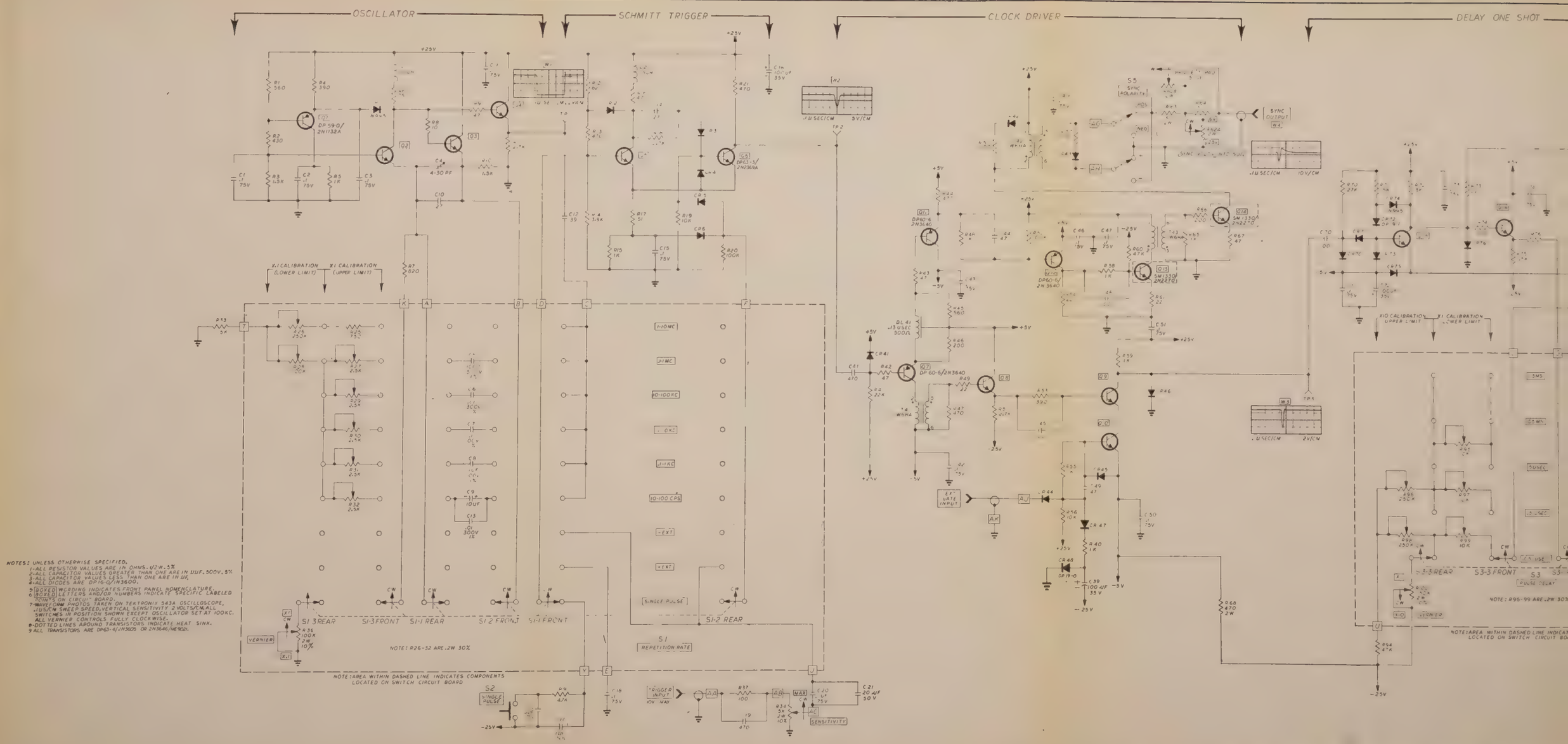
40000-053 A

C201 S6 R201	C201 S6 R251	R222-230
FIRST USED	LAST USED	OMITTED
REFERENCE DESIGNATIONS		

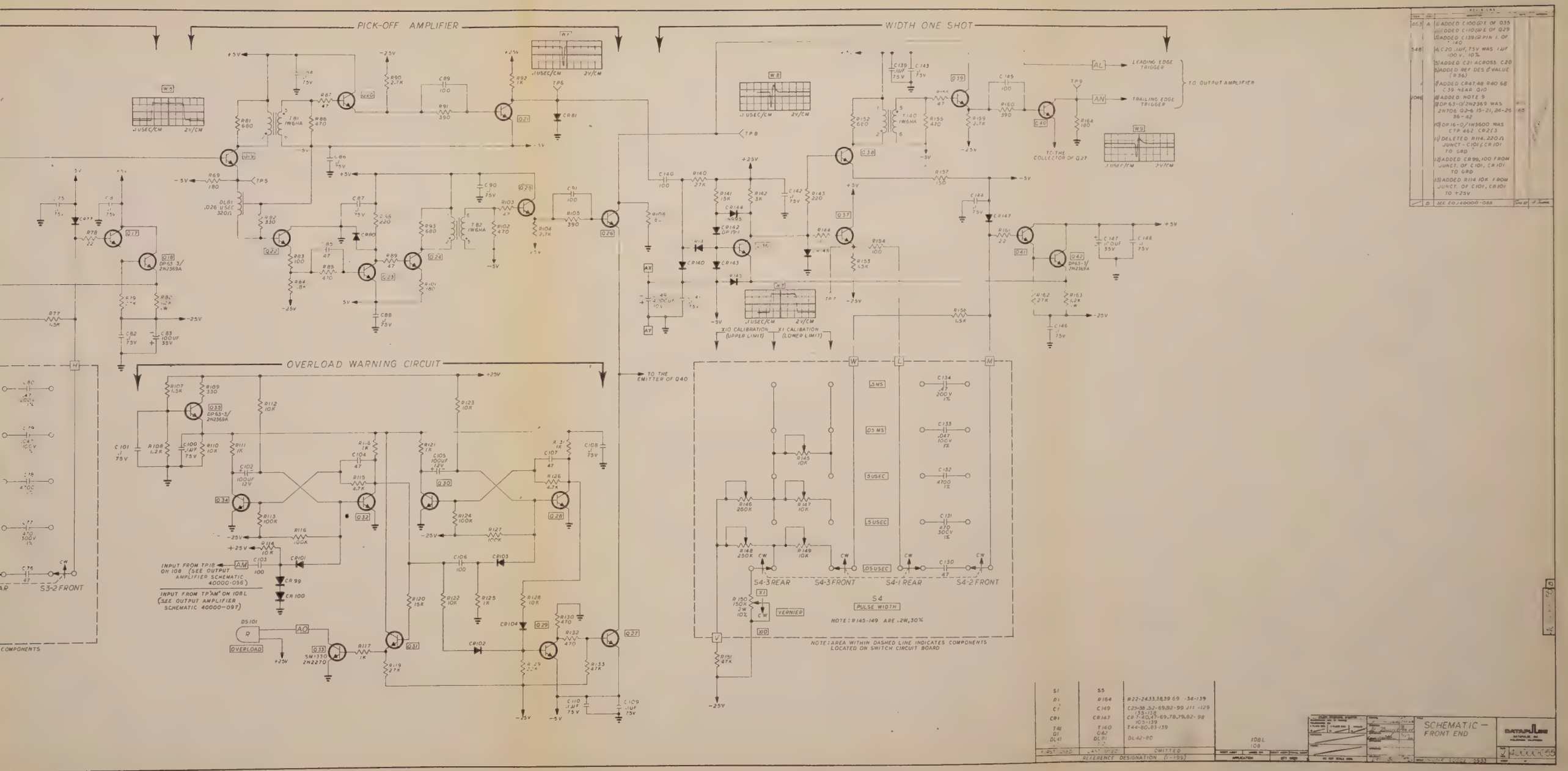
SCHEMATIC — ATTENUATOR 50 db

108 L
108
USED ON

J 40000 053



NOTES: UNLESS OTHERWISE SPECIFIED.
1-ALL RESISTOR VALUES ARE IN OHMS, 1/2W, 5%
2-ALL CAPACITOR VALUES GREATER THAN ONE ARE IN UUF, 500V, 5%
3-ALL CAPACITOR VALUES LESS THAN ONE ARE IN UF,
4-ALL DIODES ARE DP16-G/1N3600.
5 BOXED WORDING INDICATES FRONT PANEL NOMENCLATURE.
6 BOXED LETTERS AND/OR NUMBERS INDICATE SPECIFIC LABELED POINTS ON CIRCUIT BOARD
7-WAVEFORM PHOTOS TAKEN ON TEKTRONIX 543A OSCILLOSCOPE, .1US/CM SWEEP SPEED, VERTICAL SENSITIVITY 2 VOLTS/CM. ALL SWITCHES IN POSITION SHOWN EXCEPT OSCILLATOR SET AT 100KC. ALL VERNIER CONTROLS FULLY CLOCKWISE.
8-DOTTED LINES AROUND TRANSISTORS INDICATE HEAT SINK.
9 ALL TRANSISTORS ARE DP63-4/2N3605 OR 2N3646/ME902.



S1	S5	P22-24,33,38,39,69 -134-139
P1	P164	C23-38,52-69,92-99,111 -129 ,135-136
C1	C149	CR 7-40,47-69,78,79,82-98 105-139
CR1	CR147	T44-80,85-139
T48	T140	DL42-80
Q1	Q62	
DL41	DL81	
1-257-0560	-001-0020	OMITTED
REFERENCE DESIGNATION (1-199)		

108L
108

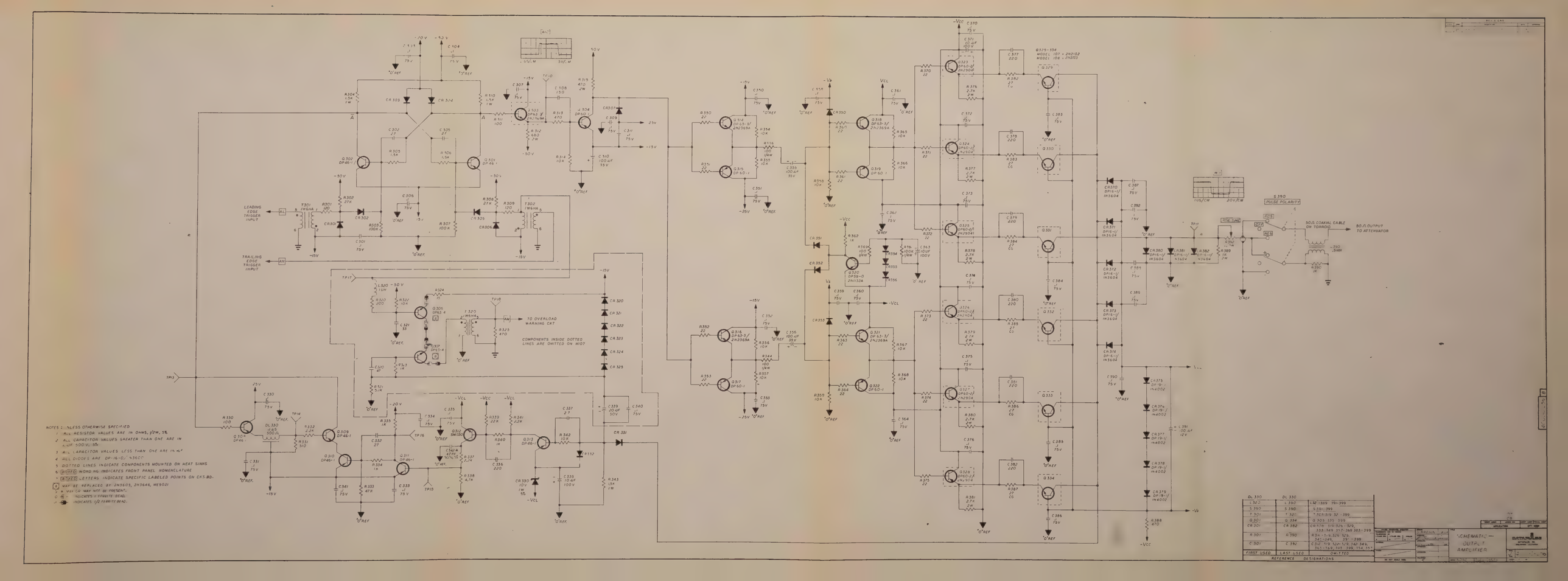
APPLICATION

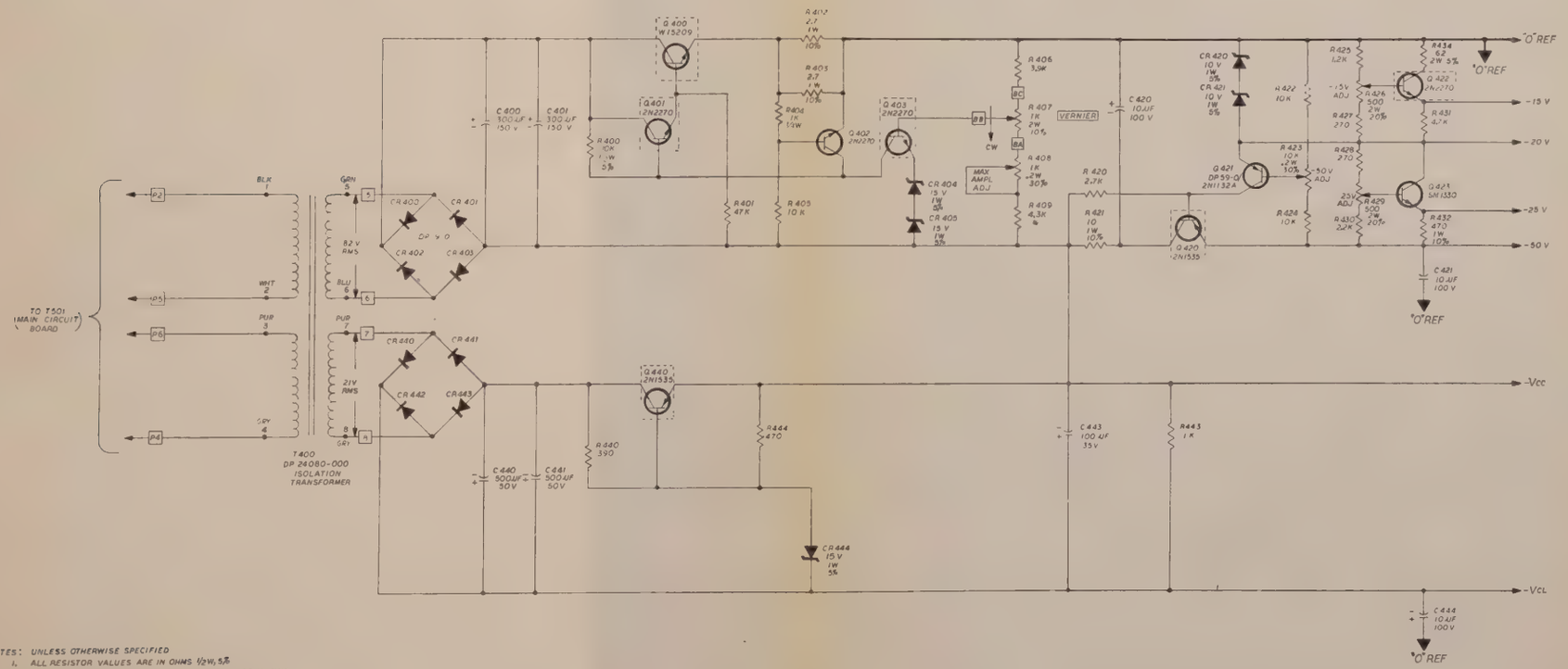
SCHEMATIC — FRONT END

DATAPULSE INC. HOLLYWOOD, CALIFORNIA

40000-055

6-63	A	(1) ADDED C100 @ E OF Q35 (2) DDED C110 @ E OF Q29 (3) ADDED L139 @ PIN 1 OF J40
5-68		(4) C20 .1UF, 75V WAS 1 UF 100 V, 10%
		(5) ADDED C21 ACROSS C20 (6) ADDED REF DES & VALUE (936)
		(7) ADDED CR47,48 @ 40 68 & C39 NEAR Q10
10-68		(8) ADDED NOTE 9 (9) DP 63-0/2N2369 WAS 2N706, Q2-6 15-21, 26-26 36-42
		(10) DP 16-0/1N3600 WAS CTP 462 CR2[3
		(11) DELETED R114, 220 Ω JUNCT - C101 & CR 101 TO GRD
		(12) ADDED CR 99, 100 FROM JUNCT. OF C101, CR 101 TO GRD
		(13) ADDED R114 10K FROM JUNCT. OF C101, CR101 TO +25V
	B	SEE EO J40000-088


LEADING EDGE TRIGGER INPUT
TRAILING EDGE TRIGGER INPUT
TO OVERLOAD WARNING CRT
COMPONENTS INSIDE DOTTED LINES ARE OMITTED ON MIOT
50Ω COAXIAL CABLE ON TORROID
50Ω OUTPUT TO ATTENUATOR
PULSE POLARITY
SCHEMATIC — OUTPUT AMPLIFIER
NOTES:
1. UNLESS OTHERWISE SPECIFIED
2. ALL RESISTOR VALUES ARE IN OHMS, 1/2W, 5%
3. ALL CAPACITOR VALUES GREATER THAN ONE ARE IN μF
4. ALL DIODES ARE DP-16-C/ IN3600
5. DOTTED LINES INDICATE COMPONENTS MOUNTED ON HEAT SINKS
6. (P-TEST) WORDING INDICATES FRONT PANEL NOMENCLATURE
7. (A) LETTERS INDICATE SPECIFIC LABELED POINTS ON CRT. BD.
8. MAY BE REPLACED BY 2N5003, 2N3648, WE903I
9. * MAY OR MAY NOT BE PRESENT.
10. INDICATES 1 FERRITE BEAD.
11. INDICATES 1/2 FERRITE BEAD.
DL 330
L 321
T 301
Q 301
CR 301
R 301
C 301
DL 330
L 390
S 390
T 320
Q 334
CR 382
R 390
C 382
FIRST USED
LAST USED
OMITTED
REFERENCE DESIGNATIONS



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS, 1/2W, 5%
2. ALL CAPACITOR VALUES GREATER THAN ONE ARE IN MMF
3. ALL CAPACITOR VALUES LESS THAN ONE ARE IN MF
4. ALL DIODES ARE DP-19-1
5. DOTTED LINES INDICATE COMPONENTS MOUNTED ON HEAT SINKS
6. [BOXED] WORDING INDICATES FRONT PANEL NOMENCLATURE
7. [BOXED] NUMBERS AND LETTERS INDICATE SPECIFIC LABELED POINTS ON CKT. BOARD
8. * MAY BE FACTORY ADJUST

T 400	T 400	
Q 400	Q 441	Q 404-419, 424-439, 441
C 400	C 444	C 402-419, 422-439, 442
R 400	R 444	R 410-419, 433, 435-439, 441, 442
CR 400	CR 444	CR 406-419, 422-439
FIRST USED	LAST USED	OMITTED

REFERENCE DESIGNATIONS

SCHEMATIC — POWER SUPPLY OUTPUT AMPLIFIER

DATAPULSE

40000-057 B

ADDENDA AND ERRATA

E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
2021	8-26-66	Transistor Equiv.	SM 1330, P/N 12685-004 is an acceptable substitute for DP63-6, P/N 22635-006.
2081	8-26-66	Transistor Substitution	2N2102, P/N 12685-005 may be used in lieu of 2N2270, P/N 12695-001.
2161A	12-15-66	L/M 37000-122 A	Calibration Sw. Assy. - Del. Sw., Width Sw. 1. Change R100 & 150 Var. Res. 150k, 2W, 10%, linear taper P/N 20053-154 to 150k, 2W, 10%, CW Modified Log P/N 20043-154 Spec. AB-JA1N056S-154AA.
2274	5-18-67	J40000-055B	Schematic - Front End 1. Delete L-1, 10μH inductor and replace with a jumper. 2. Add an asterisk (*) to C10. 3. Add Note 10: (*) indicates factory adjusted value.
2258	4-28-67	J40000-056B	Schematic Change R382 through R387 from A-B, P/N 10011-270 to Corning Glass, P/N 10721-270.
2367	11-13-67	SB 1-65	Transistor 2N2369A P/N22635-003 is an acceptable substitute for DP63-4 P/N 22635-004.
2359	11-30-67	SB 1-65	NPN Transistor equivalent: RCA 38880 is an acceptable equivalent for RCA 40250.
2407	2-2-68	Manual	Specification: 1. Minimum width: 25 ns. Add: 30 ns max.
2488	6-10-68	40000-055	1. To Gen'l. Notes, add Note 10: (*) Asterisk indicates "Factory Adjust". 2. Add Note 11: (●) indicates 1/2 bead, P/N 19170-001. 3. Add a 1/2 bead on the Emitter of Q2 & asterize. 4. Add an asterisk to C3, .1μF. 75V. 5. Change R8 10Ω, 1/2W, 5% P/N10011-100 to 68Ω, 1/2W, 5%, P/N10011-680 and asterize.

ADDENDA AND ERRATA

E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
2491	6-13-68	40000-057 40000-096	1. Change Q400 from Westinghouse NPN, 90Vce, No. 15209 (discontinued) to NPN, 100Vce, No. 15210. 2. The Part Number (12676-003) will remain the same.
2509	7-11-68	Manual	Page 1-1, Para. 1.8: Delete "Accuracy" title and statement.
2496	6-19-68	40000-056	Optional change: Change CR330 Zener diode from ZA10A, 1W, 5%, P/N 12154-022 to DP31-100 (1N758A), 400mW, 5%, P/N22314-100 (12154-041)
		40000-057	Change CR-420 and 421, same as Item 1.
2550	8-13-68	Manual	Para. 1.6, Change "Max. delay duty cycle is greater than 50% of pulse spacing..." to "Max. delay duty cycle is 30% of pulse spacing..."
2426	9-19-68	40000-056	1. Delete R390, 1k, 1/2W, 5%, P/N10011-102. 2. Delete CR375 and 376 diodes DP19-1, P/N22194-001 and replace with a jumper.

SEMICONDUCTOR REPLACEMENTS

(Applicable to all Datapulse Models except the Model 102.)

Datapulse makes extensive use of house labeled semiconductors, superseding or used in place of commercial equivalents. In most cases, these are procured against relaxed or actual commercial equivalent specifications, and commercial equivalents as listed below may, therefore, be used as replacements.

DATAPULSE TYPE NO.	DATAPULSE PART NO.	COMMERCIAL EQUIVALENT
Diodes:		
DP16-0	22164-000	1N3600
DP16-1	22164-001	1N3604
DP16-2	22164-002	HPA1003
DP19-0	22194-000	1N2070
DP19-1	22194-001	1N4002
DP19-6	22194-006	1N2071
Transistors:		
DP43-0	22435-000	2N984
DP46-0	22465-000	2N964A
DP46-1	22465-001	None*
DP59-0	22595-000	2N1132A
DP60-0	22605-000	2N2411
DP60-1	22605-001	None*
DP60-2	22605-002	2N2904 or 2N3133
DP60-3	22605-003	2N2894
DP60-4	22605-004	2N3209
DP60-5	22605-005	ft1702
DP60-6	22605-006	2N3640
DP60-7	12605-007	None*
DP63-0	22635-000	2N2369 or 2N2501
DP63-1	22635-001	2N3723
DP63-2	22635-002	None*
DP63-3	22635-003	2N2369A (Fairchild)
DP63-4	22635-004	2N3646 or MPS3646 or 2N2369A
DP63-6	22635-006	2N2270

*Replacements for the following items should be procured from Datapulse:

DP46-1 is selected from 2N2964A for high Beta.
DP60-1 is selected from 2N2894 for high V ceo.
DP63-2 is selected from 2N914 for tighter Beta tolerance.
DP60-7 is selected from DP60-1 for 25 volt breakdown.

1-10-68

WARRANTY

Datapulse Incorporated warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, transistors, fuses or batteries which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective.

Instruments returned under this Warranty will not be accepted at the Datapulse plant without prior authorization by a Datapulse representative or by the service manager of Datapulse Incorporated.

Datapulse Incorporated reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of Datapulse Incorporated and Datapulse Incorporated neither assumes nor authorizes any other person to assume for them any other liability in connection with the sales of Datapulse Incorporated instruments.

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